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J. M. WAKEMAN, - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - Associate Editor.

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CONTENTS.

	PAGE
Editorial	1
Moves in the Independent Telephone Field	4
Electrical Engineers of the Day—I: B. A. Behrend	4
Tyneside Electrical Distribution Power Plant	5
Direct Current Engineering Practice in Germany, by Charles Brandeis	11
Storage Battery Auxiliaries—V, by Lamar Lyndon	13
Improvement in the Metallurgy of Aluminum, by Clinton Paul Townsend	14
The Nernst Glower Applied to Electric Furnaces	15
Convention of the Northwestern Electrical Association	16
The Efficiency Curves of a Shunt Motor and its Relations to Operating Characteristics and the Cost of Operation	17
Incandescent Lamp Economy	19
The Industrial and Electrical Situation in Germany, by Dr. Lionel Fleischmann	21
Conversion from Alternating Constant Potential to Constant Alternating Current	21
The Telephone in Railroad Service	22
The Edison Storage Battery	24
Interurban Trolley Roads in Indiana	26
Data on New York Conduit System	26
Wisconsin Independent Telephone Meeting	26
Current News and Notes	27
LETTER TO THE EDITORS:	
Combination Dynamo Fields, by A. Grieve	27
Digest of Current Electrical Literature	28
New Book	32
Some Electrical Features at the Glasgow Exhibition	32
Battery Fan Motor Outfit	35
A New Electric "Tonneau"	35
A Telephone Test at Reading, Pa	35
Desk Telephone	36
Ferranti Iron-Type Alternator	36
A New Testing Set	37
Northwestern Convention Notes	37
Remote Control Switches	38
NEWS OF THE WEEK	39
INDEX TO VOLUME 37.	

BIOGRAPHICAL SKETCHES OF ELECTRICAL ENGINEERS.

In the earlier days of electrical engineering it was the custom of the journals consolidated as the ELECTRICAL WORLD AND ENGINEER to print from time to time biographical sketches of the leading electrical engineers of the day. When this practice was discontinued some years ago the ground had been fairly well covered, but since then an entirely new generation of engineers has come to the front. With this issue we commence the publication of a similar series of sketches, having as subjects the engineers now occupying leading positions in the profession, and which, besides the younger men, will naturally include many whose names were prominent when the sketches above referred to were discontinued. One of the criteria that will be applied in the selection of names is that the subject shall be a full member of the American Institute of Electrical Engineers, or qualified for full membership under the provisons of the new constitution of the Institute.

THE NORTHWESTERN ELECTRICAL ASSOCIATION.

The Northwestern Electrical Association summer convention held last week at Sheboygan, Wis., while not a failure as to the quality of the papers presented, was generally admitted by those present far from a success as to attendance. When an association of the size and importance of the Northwestern can hold a convention at the sessions of which less than a half dozen central station men are in attendance, surrounded by a score of supply men, it is certainly time for some one to diagnose the case. The trouble is not one that need seriously alarm those who have the interests of the Northwestern Association at heart, for it has demonstrated its usefulness and importance to its members too thoroughly to receive a permanent setback by the Sheboygan fiasco.

There are lessons to be learned from the latter, however. The winter conventions of the association have always been fairly well attended by central station men and fill a place taken by no other convention. The long and short of the matter seems to be that the association's conventions and the summer junket in particular have been bolstered up by the supply men's contingent to a point where it is practically a case of the tail wagging the dog. Any association of this kind must depend for its real success on the attendance and active interest of the central station operators. A party of supply men alone at a convention may have a very jolly time among themselves, but it is the central station element that attracts them to conventions, and if this element is lacking nothing remains to hold the convention together. The supply element has always been very active in the Northwestern Association; in fact, it has been too active. The result has been an unnatural and forced growth, the holding of conventions not justified by the interest and attendance of the central station element, and as a culmination the affair of last week. The Northwestern Association will probably confine itself to one meeting a year hereafter.

The history of Northwestern conventions has demonstrated two points. One is that the real success of the organization deepnds on the activity of the central station men, and that it is better for all concerned for the supply men to keep hands off as far as possible, attending the conventions only as visitors and omitting the elaborate

organized attempts at entertainment that have marked some of the past meetings. The central station men are more likely to take interest if they are running their own affairs than if the supply men are running things for them. The other point clearly demonstrated is that when the central station men of the Northwestern Electrical Association travel miles to a convention they mean business, and want to talk business, and that this is naturally a greater attraction than various forms of entertainment and diversion which may or may not be to their tastes and the equivalent of which they do not need to travel miles to a convention to secure. A convention once a year at some central point with an opportunity for the exhibition of some of the newer apparatus and a programme full of practical subjects will attract the central station men in the Northwestern's territory as nothing else can do, and will result in the building up of an organization from which no Western central station man can afford to absent himself.

TUNNEL PLANS AND OPERATION.

The steady advance of work on the New York Subway is investing with new interest and enthusiasm a number of plans of connecting New York City, or Manhattan Island, with the outside world by means of tunnels. There are definite plans afoot for tunnels under the Hudson, under the East River and under the Narrows, and some of them will certainly be carried out in the next few years. In each case the motive power is electricity, it being recognized now that no other power should or could be considered in connection with such work.

This universal admission of the feasibility of electric traction in tunnels has led during the recent painfully hot weather to many public expressions of wonder at the dilatoriness of the New York Central Railroad in adopting electricity as the motive power in the long, stifling tunnel by which it reaches the heart of New York City. The passage of the tunnel at this season of the year is not a pleasant experience, and consequently there are many complaints, although, rather curiously, nothing is heard about the equally unpleasant tunnels in Jersey, the inference being that people who put up with the average ferryboat and its perils will put up with anything. It is encouraging to note that the Central is said to have plans for electric traction seriously under study for adoption. The company has of late been spending huge sums on its system, from the new marble depot to the solid sunken tracks, so that questions of expenditure will evidently not be allowed to stand in the way of making travel more comfortable and secure. The only doubt can be that of a technical nature, but assuredly the accumulating evidence is now sufficient to prove to the Central management that they can drop their steam locomotives at Motthaven and come over the bridge, through the city tunnels, employing electric locomotives, with ease, success and economy. The change should, indeed, be be made at once, and the plea abandoned that it is awaiting the development of a satisfactory motor—a "reason" besides worn bare by "Uncle" Russell Sage in the service of the Manhattan.

THE CITY NEWS OFFICE.

The present age is certainly distinguished by the novelty of many of its agencies for giving public service, and those which relate to the dissemination of news have seen some very successful experimentation, nearly all depending upon the use of electricity; in fact, the wonder is that the sensational newspaper has grown up alongside the means which are most destructive of sensation and lying. With the prompt availability of the submarine cable, the telegraph land lines, the telephone, the wireless telegraph, the signaling by electric light, etc., it would seem that no wild rumor or bald inaccuracy could live many minutes or go far uncontradicted; and the fact that the rumor trade is still a fairly brisk one shows that these electrical resources are not yet utilized to their full. Of course, there will always be the rumors due to the refusal of some men to talk at all, or to the readiness of some unscrupulous folk to set stories going for the sake of the effect; but even here again electricity, with its swift transmission of intelligence, should be able to do its work of making known the real truth with instantaneity.

A curious recognition of the value of the telephone in news service has just come under our notice in some letters to the press of Mr. Franklin Ford, who seems to be preaching the doctrine that there should be a clearing house for news, and who proposes to organize some such service, in which the data of municipal work, or of various public services; the data compiled by the daily newspapers, the special items of the technical and trade press, the general information secured by exchanges, societies, etc., should all be correlated, exchanged, sifted and finally verified, so that a real fact once stamped could circulate like a certified check or a dollar bill. Here is an ingenious scheme, difficult possibly, but with underlying elements of practicability and value. But what strikes us specially is Mr. Ford's insistence on the point that with the telephone "or instantaneous communication," there should no longer be life for lies or a lingering chance for rumor in regard to any moot point in business, commercial or social life. It is of a verity one of the most extraordinary things to see men daily repeat and marvel over some rumor affecting them seriously, when by stepping to the nearest telephone they could prove or disprove it forever in four and two-tenths seconds. With many men in discussing rumors, settling the truth promptly thus, as enabled to do by telephone or telegraph is about the last thing they desire or venture.

RECIPROCITY.

The late James G. Blaine was a whole-souled protectionist, yet he was a warm advocate of reciprocity, and it has been interesting to observe how our trade ideas have slowly been approximating a logical reciprocal basis. In the case of the recent dispute with Russia, there has been absolutely no "high protection" talk in any quarter, but an evident desire to meet our old friend and ally on some reasonable footing, if it be possible. We are told from Europe that the Russian episode is but symptomatic and indicates a resolve that is quite general to crowd out the American goods that have of late been in so great demand, and that a movement has already in some vague form been started. When one considers how varied are the necessities of Europe, it is hard to believe that a common platform of active opposition to American goods could be found or has been attempted.

A Dr. Von Peez, in Germany, has been attributing to the United States a sort of cool, calculating malice in its laudable efforts to extend trade and one of his articles, freely reprinted, says: "A people so young, acute and rich in future possibilities as the citizens of the Union will find boundaries to their aspiration only when they see that attempts at further conquest will be met by vigorous resistance." So far as we can see, this utterly misrepresents the country in its policy, and our manufacturers in their sentiments, besides being all wrong on theories of trade. It is true everybody uses the phrase of "conquering new markets," but no one is compelled to buy from the conqueror. There is no need for resistance. It is purely a matter of the exercise of free will on the part of the purchaser, who buys only because he wants the article and only because the price suits him. In respect to protective policy, the United States has not stood alone, and England is the only country in Europe that can pertinently criticise her on that score. At any rate, it is only asserting

JUL 12 1901

the truth to say that this country believes in the development of reciprocal trade, and is trying all the time for more of it; the expansion of our industries and agriculture being distinctly, moreover, for the welfare of the world. The fact that we have sold fifteen hundred million dollars of product the last year shows that people are eager for our goods, and do not require to have them choked down their throats with a mailed hand, as the Herr Doctor would intimate.

CONVERSION FROM CONSTANT ALTERNATING E. M. F. TO CONSTANT ALTERNATING CURRENT.

The paper read by Professor Owens at the recent Canadian Electrical Convention, an abstract of which appears elsewhere in this issue, contains an instructive illustration of a very pretty principle, which previously had been quite fully developed by Boucherot. If we have a constant alternating e. m. f. and desire to obtain a constant-alternating current from it through a circuit of varying resistance, we choose a condenser of sufficient capacity to take that current strength steadily under the alternating e. m. f., and two equal reactances each equal to the condensance of this adjusted condenser. These two reactances are then placed in series with the varying resistance and the condenser is applied as a shunt to the varying resistance and one reactance. Under these circumstances the current through the resistance will theoretically be maintained constant no matter how the resistance may vary. The limitations are set, of course, by the resistances in the reactances which disturb the regulation.

For series arc-light circuits requiring constant-alternating currents the plan is unsuitable when the constant pressure is adapted to low-pressure supply, as in incandescent lighting, since the condenser and reactances have to be unduly large. When the constant available source of pressure is, however, fairly high, this objection dwindles and the plan would seem suitable for practical trial. The storage system by which the energy is transformed from one pressure to another has an efficiency practically the same as that of the alternating-current transformer.

It would seem that arc lamps are devices specially adapted to constant current service, while incandescent lamps are devices specially adapted to constant pressures. It is true that incandescent lamps can be operated at constant current, and arc lamps at constant pressure, but the latter arrangements always suggest misfits. On the other hand, it is sometimes very awkward to supply a constant-current system from a large station arranged for constant pressure delivery, and the small constant-current service often exacts an unduly large share of floor-space, power and attention. Consequently all methods for securing constant-current transformation are well worthy of examination and development.

CONCENTRATION CHANGES IN STORAGE BATTERY SOLUTIONS.

We published on page 1105 of last week's issue, an interesting paper by Dr. Roeber on the application of Hittorf's theory of ionic velocities to the phenomena appearing in the new Edison storage cell. It is there shown that although the density of the solution as a whole remains unchanged during charge and discharge, yet that differences in concentration tend to form in the electrolyte at the electrode surfaces and that such differences are at least partly due to differences in ionic velocity. While the deductions from Hittorf's theory are correctly stated, yet the corroboration of that theory by observations of the phenomena in the new Edison cell is rendered very difficult, partly by reason of the fact that the thickness of solution layer is reduced to a mere film in which diffusion and convection rapidly undo the work of ionic concentration, and partly because superficial concentration differences would necessarily occur by the electro-chemical combinations formed, even if the ions did not move past one another. In other words, concentration differences at the surfaces of the electrodes would occur even if no ionic migration took place, since the liberation of potassium at the nickel surface tends to form more potash at that surface, while the liberation of hydroxyl at the iron surface tends to decompose potash at that surface, the combined action being a tendency to increase the concentration at the nickel and diminish it at the iron.

The reliability of Hittorf's theory is, however, already established upon general electrolytic experience, and is readily rendered apparent in thick layers of electrolyte not subjected to the formation of secondary electro-chemical compounds at the electrodes. It would seem, for example, that the concentration differences that manifest themselves round copper electrodes in copper sulphate solution; or those which occur around zinc electrodes in zinc sulphate solution, can only be accounted for on Hittorf's hypothesis of a difference between the speed at which the anions and cations run past one another, and the deductions from that theory have not only led to fresh discoveries, but are also supplemented by a number of chemical supporting theories. In the case of the lead storage cell difference of concentration at the electrodes due to differences in speed of ionic migration are completely masked by the changes in concentration due to the absorption of hydric sulphate from the solution owing to electro-chemical decomposition. The change in density of the electrolyte, as a whole, makes it difficult to determine variations of density in different parts. Moreover, the variations of density due to electro-chemical decomposition and combination are large by comparison with the changes due to migration.

The great point of simplicty in the operation of the new Edison cell is, therefore, that while variations of concentration tend to occur at the electrode surfaces during charge and discharge, yet owing to the thinness of the solution layer these variations can readily cancel and annul each other by diffusion, leaving the solution, as a whole, in a constant condition with respect to mass, volume, density and chemical composition. The only ultimate changes in fact which transpire during the cyclic operation of the cell are changes in the oxygen contents of the active substances on the electrodes. This simplicity is not attained in other storage batteries and is not approached in any voltaic cell, since in all cases the solution is chemically altered by the action and discharge of the cell.

It is this simplicity of ultimate action which makes the Edison storage cell a special type of voltaic apparatus, and which also supports the hope of our reaching a chemically regenerative cell of this type, the transfer of oxygen in charging being then effected by some purely thermo-chemical process. The efficiency of this imaginary process of furnace charging would not be subject to the thermodynamic temperature limitations of heat engines, could probably be brought to a relatively high value, and might enable electrical energy to be obtained from coal. As regards the changes in the e. m. f. which make their appearance in the Edison cell at a certain stage of discharge, it seems likely that such change is associated with a change in the chemical conditions of the active materials, rather than with changes in concentration density of the electrolyte.

Moves in the Independent Telephone Field.

Several moves of great importance to the independent telephone movement were made last week by Cleveland people, thus greatly strengthening the position which the Forest City has long held as the center of the independent interests of America. Not the least of these changes was the announcement made by Judge Thomas, president of the Independent Association of the United States and general manager of the United States Telephone Company, that he had decided to accept the offer of the presidency of the Telephone, Telegraph & Cable Company of America, which is building independent exchanges in New York and Boston, with numerous through toll lines in New York and New England. It is said that when the Eastern position was offered him he demanded the assurance that the opposition would be fought from beginning to end, and that under no consideration should there be a sale to or a consolidation with the Bell interests. The directors of the New York company were somewhat slow in making answer to Judge Thomas' ultimatum, evidently fearing possible contingencies, but they finally agreed to the terms and last Friday Judge Thomas announced that he would accept the position. During the present week he will spend two days in Kansas City looking after the interests of the new independent company there, and about the middle of the month will take up his duties in New York. It is probable that Judge Thomas will be succeeded by Mr. Maxime Reber, at present consulting engineer for the properties of the Federal Telephone Company.

Almost coincident with Judge Thomas' announcement, and it is thought, in a measure, dependent upon it, came the announcement that Cleveland people had incorporated two companies for the purpose of systematically building up the independent movement in New York State. During the past two years the Century Telephone Construction Company, of Cleveland, has been securing franchises and building up exchanges in central New York State along the lines of the New York Central and Pennsylvania Railways. These exchanges now cover eighteen of the more important towns in the Empire State, and the new movement is for the purpose of connecting these and other towns with long-distance wires, as well as building exchanges in points not now reached. The campaign is to be conducted on the same plan as has been successfully carried on in Ohio under the leadership of the Everett-Moore syndicate with the assistance of Judge Thomas. The New York long-distance company has been incorporated as the Inter-Ocean Telephone & Telegraph Company, articles having been filed in Albany, N. Y., June 28. The capital stock is $2,000,000, divided into shares of $100 each. The controlling company, which will have for its aims the promotion of new exchanges, occupying the same position in New York that the Federal Telephone Company does in Ohio, will be known as the Consolidated Telephone & Telegraph Company. Its capitalization will be $10,000,000, and the incorporation papers have been taken out in Dover, Del.

The personnel of the new companies and character of the enterprises indicate that New York State and perhaps the whole of New England is to be systematically covered with exchanges, farmers' lines and long-distance toll lines as has been done during the past two years in Ohio and Indiana. In fact, it seems quite probable that the movement will be built up more thoroughly and that better service will be given than is now in vogue in these States. In Ohio and Indiana, many of the more important exchanges and nearly all of the smaller ones have been built up by local people with limited capital. The advantages of their position has not necessitated, until very recently, the best of service and equipment, while the numerous interests, in some cases antagonistic, has made a uniformity of rates and service almost an impossibility. It is the intention as soon as possible to connect the New York long-distance wires with those in Ohio and Indiana as well as with lines being built through the New England States.

Electrical Engineers of the Day—I.

B. A. BEHREND.

Bernhard Arthur Behrend was born in Pomerania, Germany, May 8, 1872. He received his early education from a tutor, at Varzin, Pomerania, where his parents lived remote from the nearest city with a good school, the railroad facilities at that time being very poor. The son of a man whose rare engineering and organizing abilities had won him the confidence of Prince Bismarck, with whom he had been associated for over thirty years in developing the industry of that part of Germany, his father's influence did more than the teaching of his tutors to stimulate the boy's intellect.

Mr. Behrend attended at Berlin the Polytechnical Institute and the University, studying natural philosophy and engineering under Helmholtz, Kundt, Slaby, Riedler, and a short time under Mr. Kapp, to whose influence it was mainly due that he devoted himself to electrical engineering. In spite of a strong bent of mind toward pure science, determined, perhaps, by a keen taste for the artistic side of engineering as so well illustrated by the graceful forms and lines characteristic of the constructions and designs of very able engineers, he joined, after having been for some time Mr. Kapp's assistant, the Oerlikon Company, and soon became assistant chief-electrician.

Very few men in the early nineties had clearly grasped the principles underlying the design of electrical machinery, especially for alternating currents. Assisted by the great amount of experimental material that had been and was being gained by the Oerlikon Works, and stimulated to no small degree by what he saw of the constructions of the ingenious designers, C. E. L. and Sidney Brown, Mr. Behrend was led to work out the theoretical basis of alternating current designs. He contributed to the theory of the induction motor, being the first to give a simple proof and to explain

the application of the circle diagram, now so generally used in Europe for the calculation and testing of these motors. Mr. Heyland had developed this diagram before, but in a rather abstruse and unattractive graphical manner. Prof. André Blondel took up the diagram in France after Mr. Behrend's publication, and his high authority in its advocacy was a potent factor in extending its employment.

Seeing the paramount importance of a simple determination of the drop in alternators working on an inductive load, Mr. Behrend began an elaborate experimental investigation to put to test Dr. Behn-Eschenburg's method of determining the drop in alternators. The results of this work are laid down in articles published in the German *Elektrotechnische Zeitschrift*, in *L'Eclairage Electrique*, and more recently in the ELECTRICAL WORLD AND ENGINEER.

In 1898 Mr. Behrend left the Oerlikon Works, having suffered for some time from poor health, and went to America to live with his parents, his father having become engaged in industrial undertakings in Pennsylvania. Here Mr. Behrend devoted himself to consulting engineering, to working out experimental work of former years, and to lecturing on scientific and engineering problems, having been in 1899 non-resident lecturer at the University of Wisconsin. In 1900 he was engaged by the Bullock Electric Manufacturing Company as chief engineer of its new alternating current department.

Mr. Behrend is a member of the Institute of Civil Engineers and of the Institution of Electrical Engineers, Germany; of the Institution of Electrical Engineers, Switzerland, of the American Institute of Electrical Engineers, and of the American Association for the Advancement of Science. He is the author of a treatise on the "Induction Motor."

Tyneside Electrical Power Distribution Plant.

LORD KELVIN on June 18 inaugurated the first extensive British plant for the distribution of power for manufacturing purposes, situated at Wallsend-on-Tyne, Scotland. At present the station is equipped with three 1400-hp generating units, but in his address Lord Kelvin said that this is to be regarded as only a small part of what is going to be done. What is contemplated by the Newcastle Electric Supply Company, he said, is to supply large consumers with three-phase currents for operating induction motors, and small consumers with direct current for motors and lighting. When the present plant becomes loaded another will be built on the riverside near by.

The generation is three-phase at 5500 volts, with a periodicity of 40 cycles, transmitting at this pressure and either stepping down by static transformers to 440 volts or feeding a direct-current three-wire network by means of synchronous motor generators, the motors of which work at the full pressure of 5500. The periodicity of 40 periods and the secondary voltage of 440 were settled by the fact that these worked in with both Continental and American standards, so that all classes were of apparatus obtainable at reasonable cost. The synchronous motor-generators are located in sub-stations where the direct-current feeders radiate to the three-wire distribution networks.

The ultimate equipment of plant in the present power station will consist of eight Babcock & Wilcox boilers; two 300-hp Bellis engines, each driving two 100-kw, 240-volt, direct-current generators; one 75-hp Bellis engine, driving a 50-kw, 240-volt, direct-current generator; four 1400-hp, triple expansion engines, each driving one 700-kw, 5500-volt, three-phase alternator; one 1500-kw, Parsons turbo-alternator, 5500 volts, three-phase; one 150-kw, 5500 to 240 volts, three-phase, direct-current synchronous motor generator.

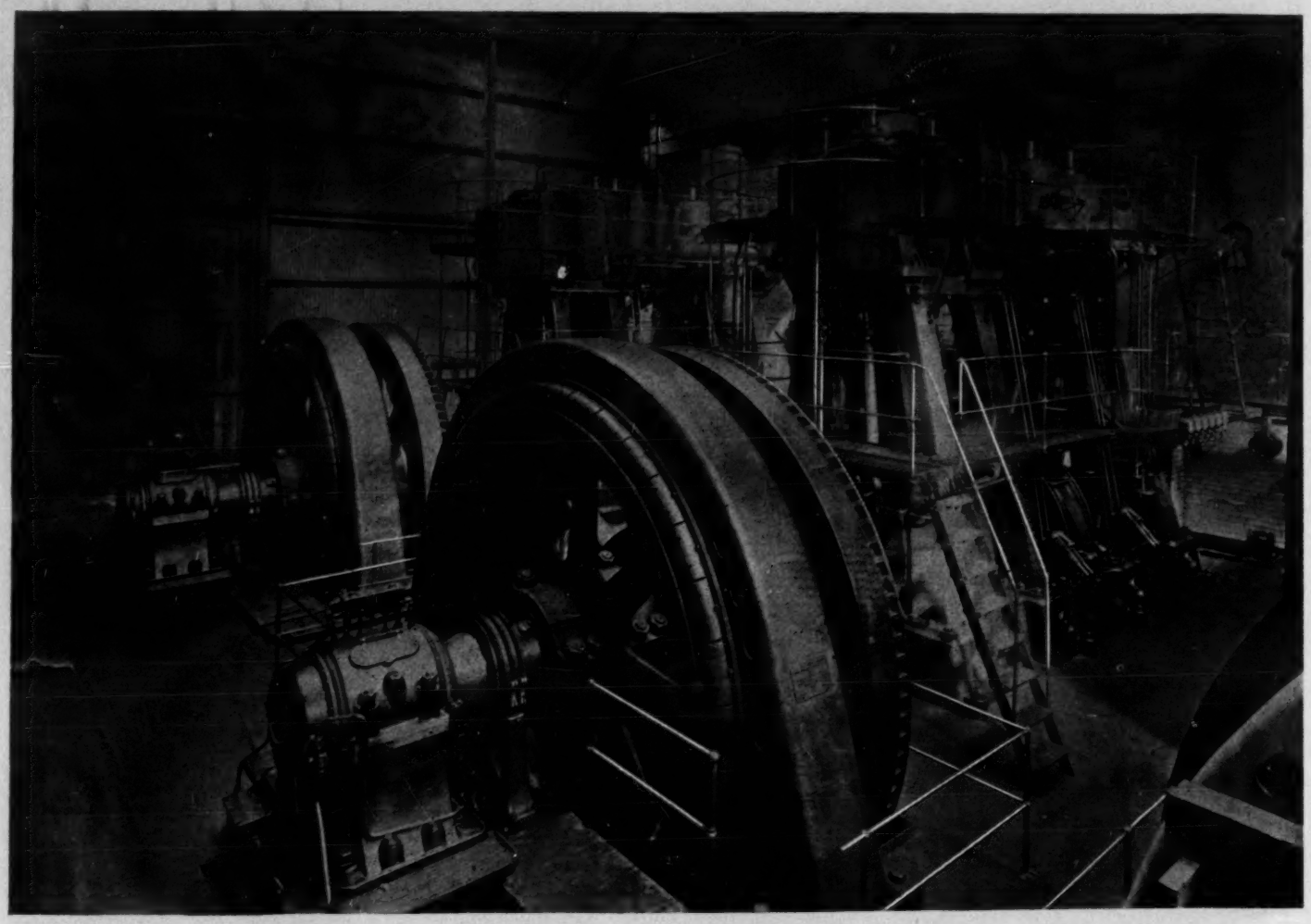


FIG. 1.—TWO 1400-HP GENERATING SETS.

ENGINES.

To drive the direct-current exciting and local power circuit generators, of which there is about 450 kw installed, three Bellis sets are provided, two of each of 300 hp and one of 75 hp. These are all of the compound two-crank, two-cylinder type, the largest sets running at 380 r. p. m., while the 75 hp set runs at 500 r. p. m. They exhaust through two grease separators into a Wheeler surface condenser placed in the engine room basement, an automatic atmosphere valve allowing them to exhaust into the atmosphere should occasion require.

The engines driving the 700-kw sets are all of Tyneside manufacture, of the triple-expansion vertical inverted type, i. e., practically marine engines fitted with governor and modified valve gear. The first of these was constructed by the Wallsend Slipway & Engineering Company, and the other three by Wigham Richardson & Company. The former are steam-jacketted throughout, and fitted with Corliss valves, all positively driven, except the steam valves on the high-pressure cylinder, which are trip valves closed by dash pots and controlled by a chain-driven governor of the Proell type. The normal speed of the engine is 100 r. p. m. and an Aspinall's governor mounted in the rocking air pump lever shuts off steam when the speed rises above 115.

The air pump is driven by a rocking lever off the high-pressure crosshead while the centrifugal circulating pump is placed in the basement underneath and driven by a continuous current motor.

The surface condenser is supported on the back framing of the engine columns, an automatic valve being provided so that in the event of the circulating water failing the low pressure cylinder may exhaust into the atmosphere. The engine will, when on the atmosphere, drive the generator at full load (700 kw) and will also in these conditions fill the specifications as to governing and angular velocity.

The three Wigham Richardson's engines are to a similar specification as the Slipway set, so far as output, speed, atmospheric exhaust, angular velocity, governing, etc., are concerned. They are also self-contained with surface condenser direct driven Edward's air pump, Aspinall's emergency governor, and motor driven centrifugal pumps, but in other respects they present certain novel features. They have four cylinders, two low pressure, and the four cranks are not set exactly at 90 degrees, but are balanced on the Yarrow, Schlich & Tweedy system, the object being to do away with all vibration, and

to secure even turning moment without the use of a heavy fly-wheel. The engine is controlled by a governor of the flywheel type (Stump's patent) mounted direct on the crank shaft.

ALTERNATORS.

The large alternators are of the three-phase type with revolving fields and stationary armatures and were supplied by the British Thomson-Houston Company, Limited. Each machine is placed tandem to its engine, the field being mounted on an extension of the engine shaft 24 inches in diameter. The armatures are arranged to slide parallel to the shaft on base plates secured to the foundations by bolts.

The normal output of each generator is 700 kw at 5500 volts, the speed being 100 revolutions per minute. The fields have 48 poles, thus giving a frequency of 40 cycles per second. The armature winding has one slot per pole per phase, and the shape of the pole pieces is such that the wave shape approximates closely to that of a sine curve.

The normal exciting voltage is 240. Carbon brushes are used for the collector rings. The commercial efficiency of the generators is not less than 95 per cent at full load and 91½ per cent at half load, excluding the excitation, and the generators will carry an overload of 25 per cent for half an hour without injury. The rise of voltage upon throwing off full non-inductive load does not exceed 7½ per cent, and the temperature rise after a ten hour's run at full load does not exceed 40 deg. C. as measured by thermometer.

DIRECT-CURRENT GENERATORS.

Each set consists of two 100 kw generators supplied by the British Thomson-Houston Company, connected up tandemwise to a Bellis engine, the arrangement being such that the armatures are interchangeable. Each has an output as a shunt machine of 100 kw at all voltages from 260 to 270 at a speed of 380 revolutions per minute, and as compound machines they give 250 volts at no loads and 262 at full load. After 24 hour's run at full load the surface temperature of any part of the armature or field windings does not exceed 45 deg. C. above that of the surrounding air.

MOTOR-GENERATOR IN GENERATING STATION.

The motor-generator in the power house was supplied by Messrs. Richardsons, Westgarth & Company, and is designed for use in both directions, that is to say, either for receiving alternating, three-phase currents and delivering direct current, or vice versa. The set consists of one three-phase synchronous motor wound for the full pressure of 5500 volts, direct-coupled to two direct-current machines, each machine having an output as a shunt machine of 75 kw when running as a generator at 400 revolutions per minute. Each machine is shunt and compound-wound, and gives at full load 240 to 270 volts. The combined commercial efficiency of this set at full load and normal voltage and running either way is not less than 85 per cent. The temperature rise after ten hours' run at full load does not exceed 72 deg. F. above that of the surrounding air as measured by thermometer.

SWITCHBOARDS.

The high tension switchboard was supplied by Messrs. Ferranti, and consists of 17 panels, namely: six generator panels, one motor generator panel, two wattmeter panels, and eight feeder panels, and is suitable for working at 6000 volts three-phase. Each panel contains three fuses, three switches and three ammeters, and provision is made for disconnecting any panel from the bus bar when alive by means of insulated tools. Bus-bar voltmeter and synchronizing gear in duplicate is provided at the top of the board. The two wattmeters are required for measuring the respective output of the two companies operating the power station.

The low tension switch equipment consists of three boards, two being on the floor level and one being in the switchboard gallery. These panels deal with the two 200-kw Bellis sets, a small exciter set, and the 150-kw motor generator. One of the boards on the floor level holds the main dynamo fuses, the compounding switches, and the field switches. The main low tension board is on the gallery and contains three sets of bus bars, namely, station power and lighting bus bars, exciting bus bars, and feeder bus bars. The station bus bars and exciting bus bars are arranged one on each side of the

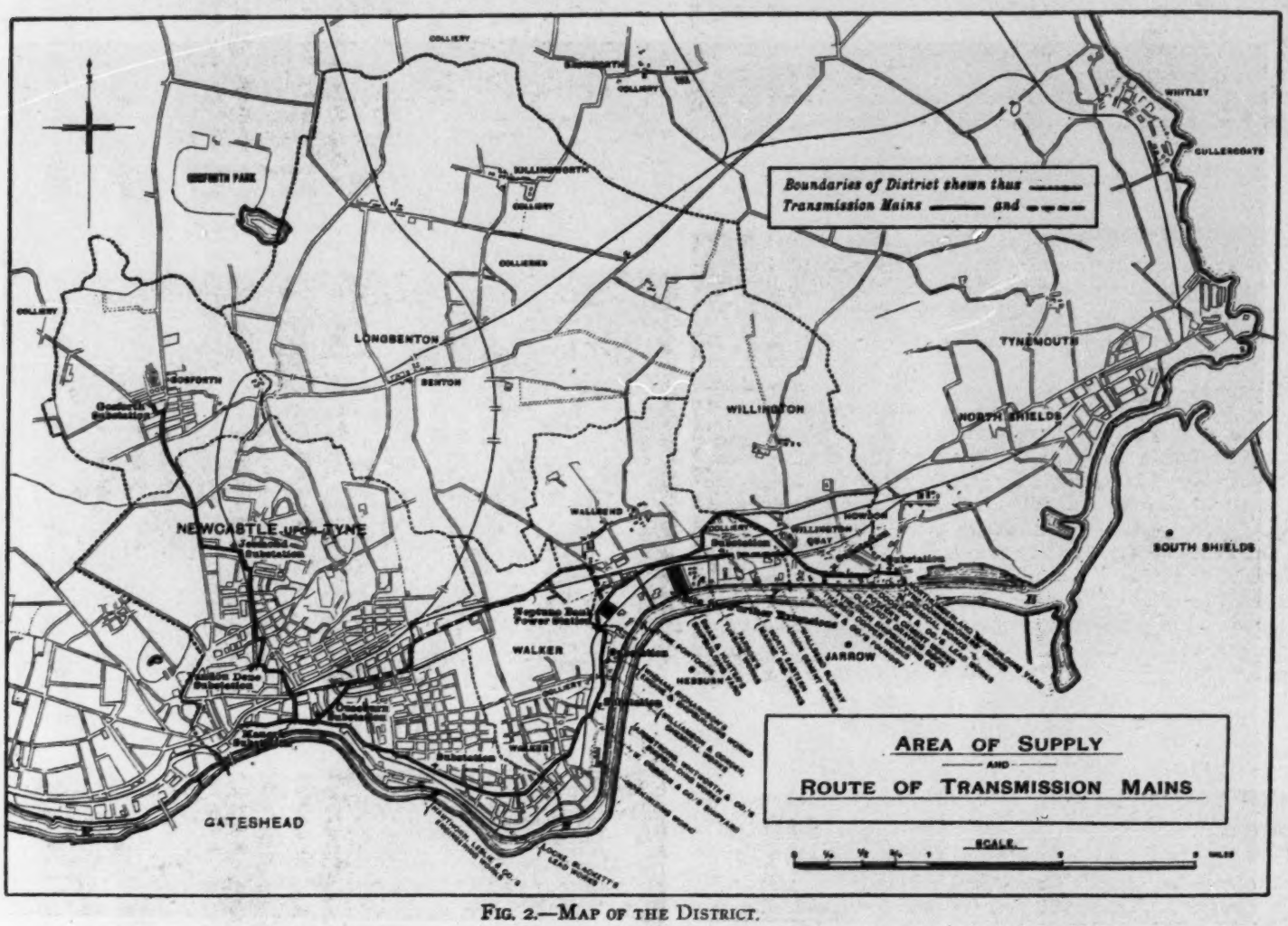


FIG. 2.—MAP OF THE DISTRICT.

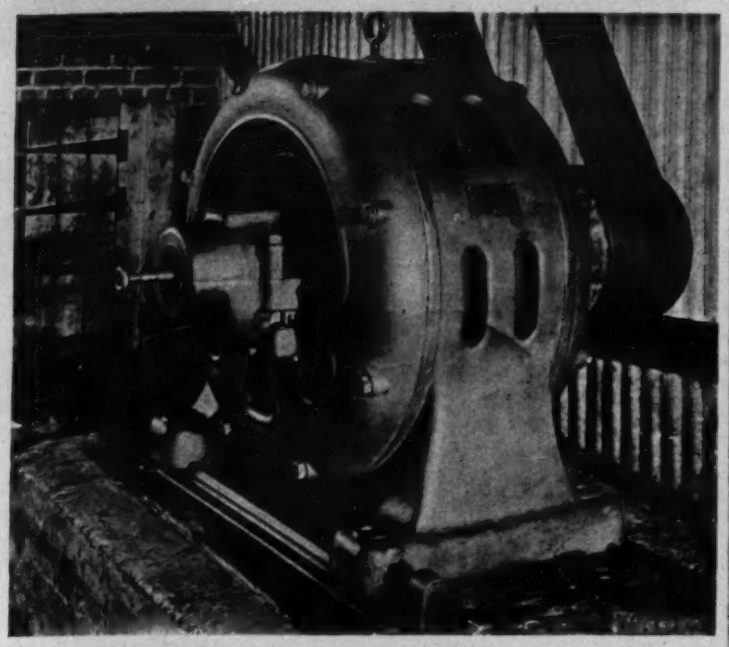


FIG. 3.—TYPICAL 30-HP THREE-PHASE MOTOR.

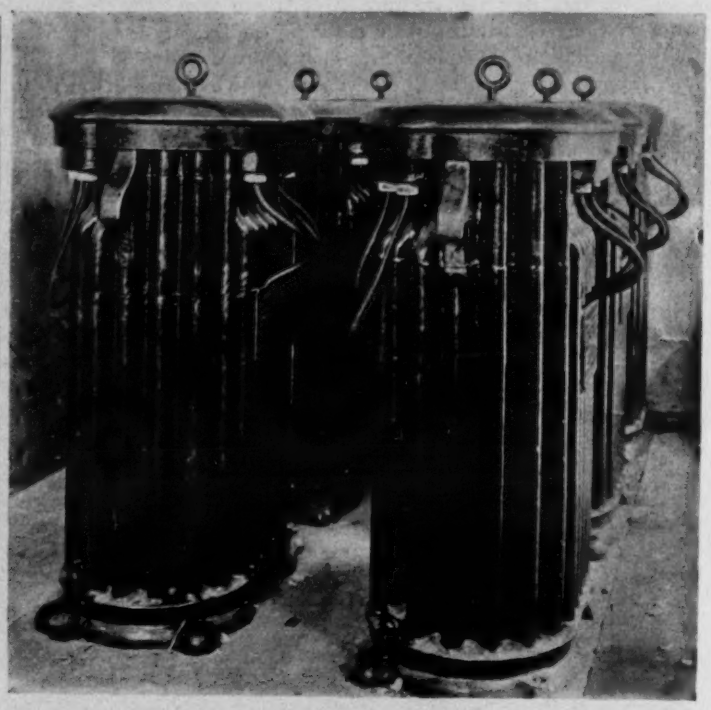


FIG. 6.—50-KW TRANSFORMERS.

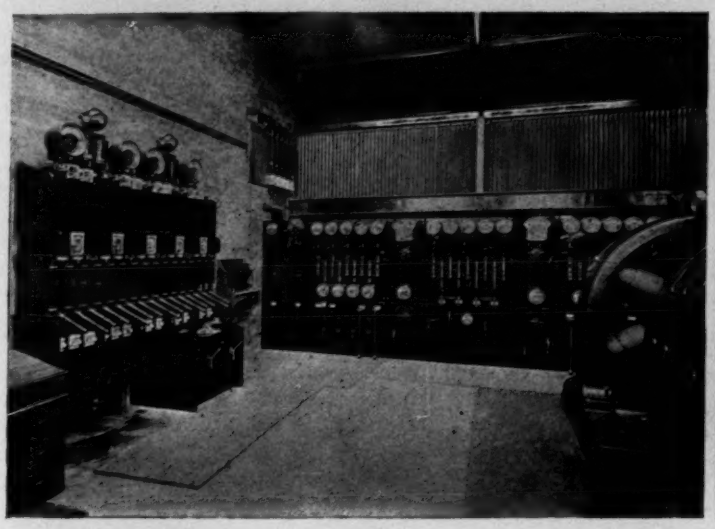


FIG. 4.—HIGH-TENSION AND LOW-TENSION SWITCHBOARD IN NO. 1 STATION.

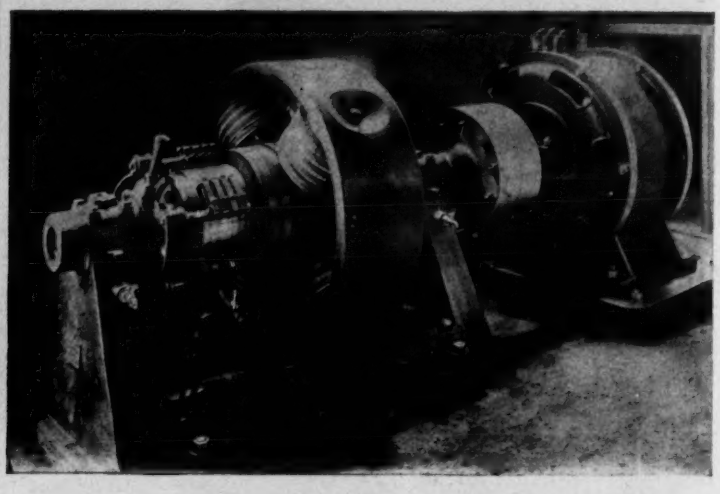


FIG. 7.—75-KW MOTOR GENERATOR.

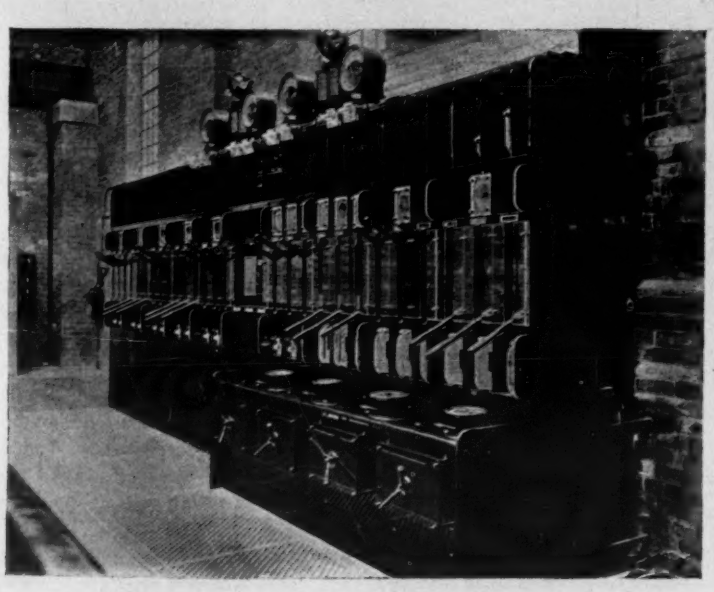


FIG. 5.—HIGH-TENSION THREE-PHASE FERRANTI SWITCHBOARD.

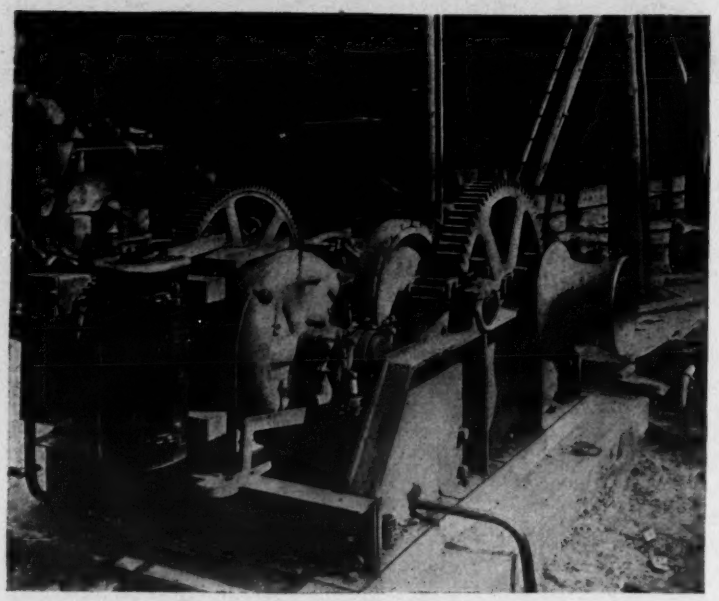


FIG. 8.—THREE-PHASE THREE-TON WINCH, WITH COVER OFF.

THE TYNESIDE ELECTRICAL POWER DISTRIBUTION PLANT.

system, so that the station power and lighting circuits and the alternator exciting circuits are each operated quite independently at 250 volts. In this way the exciting circuits are kept entirely distinct from anything else, thus greatly reducing the liability of any mishap to the excitation. Double throw switches are provided by which any generating set can be thrown on to these bus bars or on to the feeder bus bars. The feeder bus bars are connected through a watt-meter panel to the feeder board which is arranged for four sets of three-wire feeders, and also includes a traction panel for the supply of power to the shunting locomotive in the yard outside.

TEST POND.

A test pond has been constructed outside the station for the testing of the various generators. The arrangement consists of three plates of lead immersed in a brick pit filled with water. Each plate is separately suspended from a rope passing over a pole carried on a wooden staging above the pit. Three windlasses are provided at a safe distance from the pit by means of which each plate can be raised and lowered independently, and thus the load can be readily balanced and adjusted. Overhead wires connect these plates with terminals fixed on the wall of the switchboard gallery from which temporary connections are made for testing any of the three-phase or continuous current generators, the pond being of sufficient capacity to absorb 1500 kilowatts at 5500 volts.

AUXILIARY MOTORS.

The following auxiliary motors of Bruce Peebles make are provided in the station: Five centrifugal pump motors, each 20 hp at

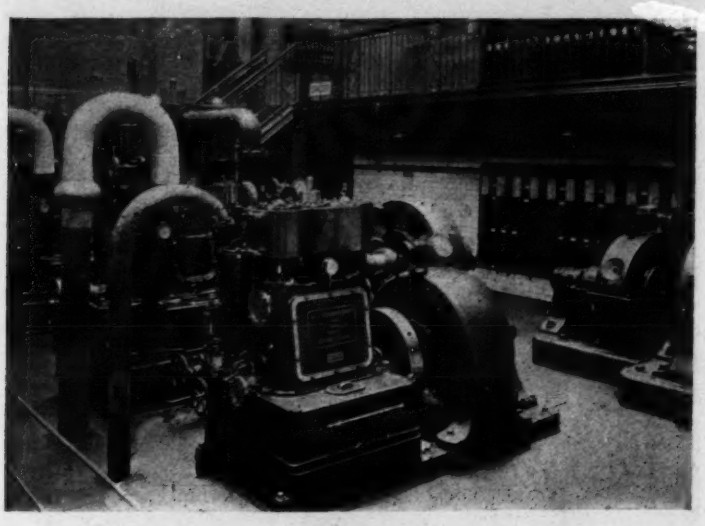


FIG. 9.—DIRECT-CURRENT GENERATING SETS AND PANELS.

800 revolutions; four barring gear motors, each 6 hp at 1000 revolutions; one air compressor motor 2 hp at 200 revolutions; one vacuum pump motor, ½ hp at 600 revolutions; one stoker motor, 15 hp at 900 revolutions; one economizer motor, 2 hp at 700 revolutions; one ash hoist motor, 6 hp at 600 revolutions; one river pump motor, 15 hp at 350 to 700 revolutions; one air pump motor, 40 hp at 100 revolutions.

CABLES.

The high-tension cables are all of the three-core paper-insulated lead-covered type laid solid in iron troughs, the various troughs being bolted together. The low-tension, direct-current cables are single core insulated with vulcanized bitumen and laid solid in separate earthenware troughs covered with hard tiles.

The main transmission cables to Newcastle are also of the three-core type, each core having a sectional area of .25 square inch; they are paper insulated, lead covered, and are, further, in the case of Callender's make, surrounded with an armor of galvanized steel wire. The function of this covering is not, however, that of protecting the cable from mechanical injury, but it is put on in order to meet the Board of Trade requirements as to conductivity of earth sheathing. The other maker, the British Insulated Wire Company, fills these requirements by providing just under the lead a continuous layer of copper tape.

The drawing system has been adopted for the transmission mains, the ducts consisting of four-inch earthenware pipes. There are nine of these pipes in each transmission route, laid in layers of three deep and embedded in concrete.

A separate cable will be carried up from Wallsend to the three main sub-stations, these sub-stations being inter-connected, both on their high and low tension side, but while the interconnector is in the latter case only meant to be used on very light loads the high-tension connecting cables are, on the other hand, of the same section as are the main Houston-Thomson cables from the generating station.

SUB-STATIONS.

The three main sub-stations are practically identical in design, the only difference being in their overall length, which was affected by the available site area. They have all a length of about 80 feet and a width of 35 feet, being designed for an eventual capacity of 2000 kilowatts in synchronous motor generators. The equipment of each at present consists of two 500-kw synchronous motor-generators, one 75-kw asynchronous balancing set, and one 25-kw direct-current balancer.

The large motor generators for the sub-stations in Newcastle were supplied by Messrs. Richardsons, Westgarth & Company, Limited, and manufactured by Brown Boveri, of Baden, and two—the first installment for one of the sub-stations—by the British Thomson-Houston Company, Limited.

Each set will consist of one three-phase synchronous motor, wound for the full pressure of 5500 volts, coupled to a single direct-current generator. The two machines of each set are mounted on one bed-plate. The motor has a fixed armature and revolving field and the armature winding is star connected. The full load output of each direct-current set is 980 amperes at 510 volts, and the three-phase motor is so designed that by means of a field rheostat the power factor at full load can be varied from 1 to .8, the wattless current being a leading current. No part of the apparatus except the commutators in continuous running at the full load will rise in temperature more than 40 deg. C. as measured by thermometer, and no part of the commutators will rise in temperature more than 45 deg. C. The motor generators will be capable of running for one hour at an overload of 25 per cent without excessive rise of temperature in any part or injurious sparking, the position of the brushes being fixed for all loads.

The efficiency is guaranteed not to be less than 89 per cent at full load, 87 per cent at two-thirds load, and 78 per cent at one-third load.

The high-tension sub-station switchboards consist of a feeder board and a motor generator board which are placed at right angles, and which are connected through a panel which will contain watt-meters and power factor indicators dealing with the total power being taken by the motor generators.

Each board consists of two parts, a lower frame and an upper frame. The lower frame is located beneath the floor of the switchboard gallery and contains the high-tension bus bars, switches, fuses and instrument transformers. The upper frame contains the rheostats, indicating instruments, and handles for operating the main switches. The main switches are of the oil type and are geared to the operating handles by means of a chain and sprocket wheels. All the instruments, both voltmeters and ammeters, are operated through transformers. The whole of the high-tension parts are thus kept below the floor, and thus safety in ordinary working is secured since all high tension parts are inaccessible to the operator on the gallery.

NEWCASTLE SUBSTATIONS.

The low-tension sub-station switchboards are divided into three portions, namely, positive, negative, and neutral positions, which are separated by two voltmeter panels. There are three sets of horizontal bus bars and any generator, balancer, or feeder can be connected to any of the three sets of bus bars by means of the usual arrangement of vertical bars and screw plugs. The board is designed for ultimately dealing with four 500 kilowatt motor-generators, two balancers, and nine feeders, some of which will be interconnectors between sub-stations. For starting the synchronous motor generators an arrangement of switches is provided by which any motor generator can be connected with a special starting panel which is fitted with starting resistances and an automatic cut out, and is located at one end of the low-tension switchboard. The backs of the voltmeter switches are covered in with neat brass cases and all voltmeter wires are run in metal tubing, thereby securing a neat and safe arrangement of the back of the board. The dynamo fuses and field switches are located on panels fixed on the wall supporting the switchboard gallery.

All the low-tension cables in Newcastle are of Callender's make, single core, vulcanized bitumen, each cable laid in a separate chase of an earthenware trough, which is then filled in solid with the bitumen and covered with a hard tile 2 inches thick. Single pole disconnect-

ing boxes only are used throughout; these are of Callender's design of the "Cork" type fitted with diving bell cover.

DISTRIBUTION.

In addition to supplying manufacturers with power the companies have undertaken to install all apparatus which may be required for power or lighting purposes free of first cost to the consumer, charging a rental per annum based on the capital cost to the company of providing and installing the plant. In this way manufacturers are relieved from having to go to any great expenditure and at the same time are freed from all trouble and responsibility in connection with the various branches of the work.

For an additional sum per annum the companies are prepared to do all the maintenance in connection with the installation renewing of bearings, adjusting of brushes, trimming arc lamps, etc., etc., and keeping the installation generally in good working order.

Owing to the great variety of the manufacturers' requirements which the plant is called upon to supply, difficulties have been met with which have made it impossible to adopt one system of supply throughout, and also have rendered it difficult to standardize the apparatus used. Where the matter was left to the company's engineers, as is the case in most of the yards, they recommend the three-phase system, especially for all constant speed work; but as some of the manufacturers prefer direct-current, arrangements have been made for supplying current on one or other, or both, of these systems as may be required.

On account of the quantity of direct-current required, and the fact that it is more suitable for arc lamps, direct-current distributing mains had to be laid throughout most of the district along the river side. This being so, it was convenient to do all lighting on this system, and thus avoid the necessity of keeping the three-phase voltage to within one or two per cent., the direct current being supplied through motor generators.

As has been previously stated the power is supplied at a pressure of 5500 volts, and for the purpose of reducing this to the working pressure of 440 volts a separate sub-station has been provided in those works which are too far distant to allow of their being supplied with low-tension currents from one of the main sub-stations. Each sub-station is in direct telephonic communication with the power house.

The plant is now supplying power to a number of the largest shipyards and engineering works on the north side of the Tyne, in the majority of which the power is supplied on the three-phase system. As practically the same arrangements have been carried out in the various yards in which the installation has been designed by the company's engineer it will suffice, for the present purpose, to detail the arrangements in one yard which may be taken as a typical example.

A large section of Messrs. Sir W. G. Armstrong Whitworth & Company's shipyard is now driven electrically, the total motors being installed at present aggregating some 400 horse-power.

Owing to every inch of ground being valuable a site for the sub-station was with difficulty selected. On this a brick building measuring 28 feet by 13 feet 6 inches has now been erected. In this building

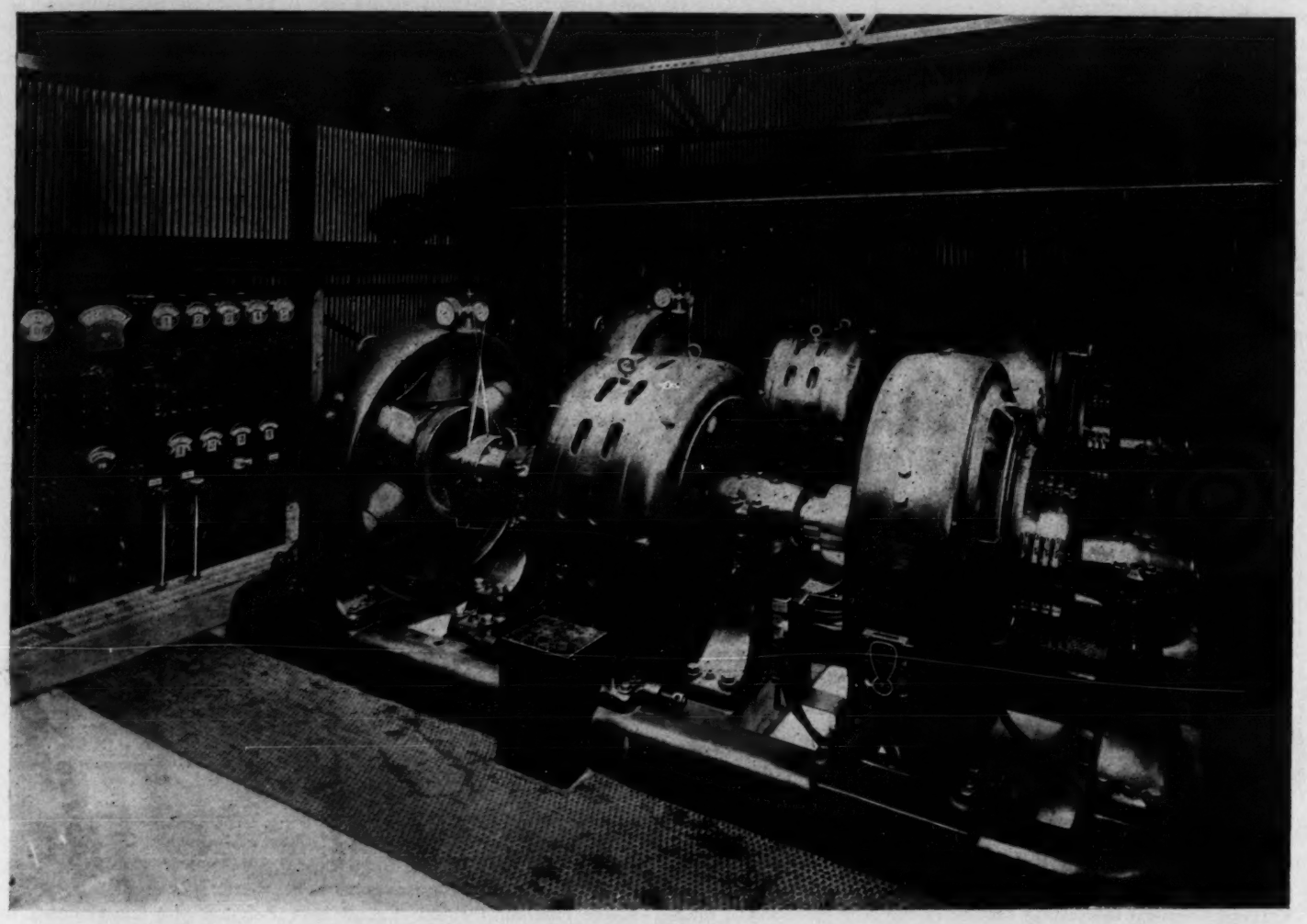


FIG. 10.—300-KW MOTOR-GENERATOR IN SUB-STATION.

are installed the necessary transformers and switchboard panels.

The high-tension switchboard, which is of Messrs. Ferranti's make, consists of two feeder and two three-phase transformer panels. Each feeder panel has been arranged for carrying 150 amperes in each phase, an ammeter being provided in one phase only.

The transformer panels are erected to the right of the feeder panels, and the board is capable of extension in either direction without any alteration being made to the existing panels.

Seven 50-kw British Thomson-Houston single-phase transformers have been installed, six of which are in use, the seventh being kept as a spare. All the transformers are connected-up delta, and in this way a failure of one does not affect the supply.

The low-tension transformer and circuit panels have been erected on the opposite side of the building. These are mounted with three fuses, one ammeter and one triple-pole switch.

The yard is divided into various sections, each of which is controlled by a separate circuit panel in the sub-station. The main cables leading from the sub-station have been run overhead, each circuit terminating at a distributing board. All overhead lines are efficiently protected from lightning discharges by means of reactance

coils and spark gaps. The standard distributing boards consist of cast iron boxes of special design, equipped with the requisite number of panels. They are made in different sizes suitable for taking from three to nine panels each, and are equipped with either power or lighting circuit panels according to the requirements of the case, the overall dimensions of the various classes of panels being identical.

In order to guard against the risk of a short circuit in a power distributing box, i. e., boxes equipped with fuses of over 5 amperes capacity, single pole boxes are used throughout. Wherever the cables strike down to a distributing box or motor they are run in iron pipe so as to protect them from mechanical injury.

The motors throughout this yard are of the induction type. Of the 29 motors which are being installed 10 drive line shafting, the remainder driving individual machines. Three types of motors are used—one having a squirrel cage rotor, while the others are form wound.

For the purpose of starting the former type of motor a compensator is employed in order to reduce the voltage at the station terminals. Combined with these compensators is an oil break switch so that in starting up a motor it is only necessary to actuate one handle. Owing to the possibility of placing this compensator at any distance from the motor this type has been used when the motors have had to be erected in out of the way positions.

Of the other types one carries a starting resistance mounted within the rotor itself. On starting up, this resistance is cut out by means of sliding contacts actuated by a handle through the hollow spindle

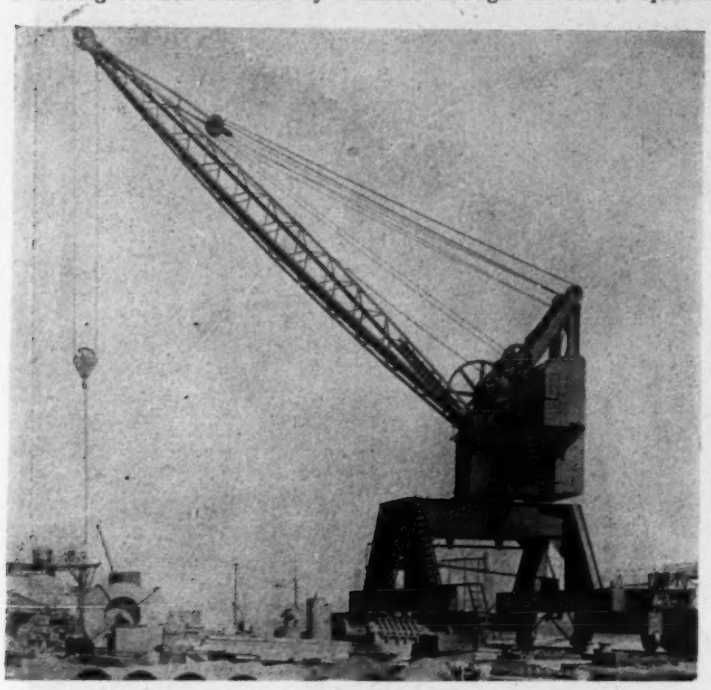


FIG. 11.—TWENTY-TON THREE-MOTOR CRANE.

of the motor, while the others are provided with collector rings and are used where variable speeds are required.

Perhaps the most interesting feature in the Northumberland Shipbuilding Company's installation is the electric winches. At present eight of these have been installed, each of which is driven by a 10-hp variable speed induction motor, which is capable of being run in either direction, all directions and speeds being controlled by one handle. Each winch will lift a load of 3 tons at a speed of 50 feet per minute from either of the two warping drums. As will be seen from the photographs reproduced, the winches are provided with covers and are generally designed so as to be thoroughly protected both from mechanical injury and from the weather.

As these winches are erected in the neighborhood of ship's berths the cables which supply them with power have been laid underground in wooden troughs and run in with bitumen. In this way they are protected from injury from falling spars, etc. The Northeastern Marine Engineering Company is one of the largest consumers within the company's area and is supplied on the direct current system at a pressure of 480 volts between the outers, the motors themselves, all being run 240 volts circuits. Up to the present time about 1600 horse-power in motors is being installed. The power for this yard is supplied from one of the sub-stations which is situated in close proximity to the works.

The sub-station, which is the largest on the Gas Company's system, measures 30 feet by 25 feet inside, and is equipped with a 7½-ton travelling crane.

INDUCTION MOTORS.

The following particulars refer to three-phase induction motors, working at a frequency of 40 cycles per second. There are three classes of motors. The motors of Class 1 have rotors with short circuited squirrel cage windings. To cut down the starting current when the maximum starting effort is not required, a starting compensator is used.

The motors of Class 2 have wound rotors with resistances in series with the windings. This resistance is cut out as the motor speeds up by means of a handle projecting from one end of the shaft.

The motors of Class 3 have wound armatures, the windings being taken to 3 collector rings on the shaft, and variable speed is obtained by means of resistances external to the motor inserted in the rotor windings.

The motors are partially enclosed and are designed to run on 440-volt circuits. The temperature rise is guaranteed not to exceed 40 deg. C. as measured by resistance after a 24 hours' run at full load as semi-enclosed motors. Small motors will reach their limiting temperature in 3 hours, and larger ones will take considerably longer.

The maximum torque of type 1 comes at a point varying for different motors, and about 20 per cent below full speed. If the overload continues, the torque remaining the same, after the motor falls below the maximum torque point it cannot be started without adjusting the resistance of the armature circuit in the case of a type 2 motor; and a type 1 motor cannot be started at all until the torque is reduced below the maximum starting torque for that motor. If, however, after the load has caused the motor to break down the torque be reduced sufficiently rapidly as the speed falls, a certain point will be reached where the torque becomes less than the maximum torque the motor is capable of yielding at that speed, the motor will then pick up and come up to speed again. The torque curves vary for different sizes of motors and different windings. The drop at speed from full load is from 6 per cent for smaller sizes to 3 per cent for larger sizes. The maximum output is about two times full load for 1, 2 and 3-hp motors and from 2½ to 3 times full load for larger sizes.

The maximum starting torque is 1½ times full load torque for 1, 2 and 3-hp motors and from 1½ to 2 times full load torque for larger sizes. The minimum starting torque and current is from about full load to 1¼ times full load torque and current.

The motors of type 3 are very flexible and can be wound if required for heavy starting torque up to twice full load torque.

Mr. Charles H. Merz, to whom we are indebted for the above details of the plant, is consulting engineer for the Tyneside enterprise. Mr. H. L. Riseley is resident engineer for construction of the station.

Paris-Berlin Automobile Race.

A great continental automobile race was witnessed last week, from Paris to Berlin, over a course 724 miles long. No fewer than 162 automobiles were entered for the race, and some 60 more went along in advance as tourist spectators. The course was divided into three stages running through France and Belgium and Luxembourg to Aix-la-Chapelle and thence through Dusseldorf and Hanover, to Berlin. The start was made from Champigny, 12 miles outside Paris. There were some notable instances of careful preparation for the contest. One firm of motor car builders had a staff of seventy-seven mechanics on the ground to inspect its cars before they started. A firm of oil men distributed 1300 gallons of gasolene at various points along the route.

So far as known, only one American, Foxhall Keene, was in the race, and his Mors machine was early disabled by a broken tire, landing him in a potato patch. The winner was Mr. Henri Fournier, in another Mors, whose speed is said to have averaged 40 to 45 miles an hour, although the exact time occupied is not stated in any of the dispatches. All of the first five arrivals were Frenchmen, and their reception at the West End course just outside Berlin, by a crowd of several thousands, was very enthusiastic. Mr. Fournier was the winner of the last Paris-Bordeaux race, when he made the 348 miles in 6 hours 11 minutes. Although the roads traveled have been in existence for hundreds of years, they are spoken of as being bad outside France, and as being often "execrable" and "awful." About a score of automobiles appear to have finished within a few hours of Fournier's arrival.

Direct-Current Engineering Practice in Germany.

By CHARLES BRANDEIS.

WHILE in this country compound-wound dynamos are universal in use, this is very rarely the case in Germany, especially for lighting purposes. This is explained by the fact that the engineers in that country favor the use of storage batteries working in parallel with the generators, because of the advantages they have in assisting the latter during the peak of the load and enabling the entire steam plant to be shut down during light loads without interruption of the service. Thus the steam engines can always be worked at full load, and consequently with high average efficiency. Moreover, the storage battery ensures constancy of bus-bar pressure and makes the latter more independent of the generator voltage fluctuations.

According to published statistics there were in Germany up to March 1, 1900, 652 central stations in operation, of which 568 had direct-current systems, and of these only 43 are operated without storage batteries. Since compound-wound dynamos are not siutable for storage batteries, the result is that shunt-wound machines are most widely in use, the former rarely even for street railway work.

Thus the German engineering practice is entirely different from that of this country, and hence a description of their methods will porbably be of interest.

In the accompanying diagrams the following notation will be employed:

D_1, D_2, etc.. shunt-wound generators.
BD_1, BD_2, etc., booster dynamos (shunt wound).
BM_1, BM_2, etc., booster motors (shunt wound).
B, storage battery.
F_1, F_2, F_3, etc., fuses.
A_1, A_2, A_3, etc., ammeters.
V_1, V_2, etc., voltmeters.
VS_1, VS_2, etc., voltmeter switches.
I_1, I_2, etc., indicators.
S_1, S_2, etc., S. T. switches.
O_1, O_2, etc., D. T. switches.
Sh_1, Sh_2, etc., field magnet windings.
R_1, R_2, etc., rheostats.
CR_1, CR_2, etc., cell regulators.
CB_1, CB_2, etc., circuit breakers.

Fig. 1 to 6 show diagrams for two-wire, Figs. 7 to 13, inclusive, for three-wire systems.

Fig. 1 shows the simplest method of operating a battery in multiple with generators. It has the disadvantage that lights cannot be operated simultaneously with the charging of the accumulators unless a rheostat R_2 is inserted, as shown for the reason that as the charging proceeds, the generator e. m. f. has to be continuously raised. This rheostat is, however, expensive, and, moreover, wastes considerable energy. The indicator I_1 indicates the direction of the current—that is, whether the battery is discharging or being charged. This instrument is frequently combined into one with the battery ammeter, the latter then having its zero in the middle of the scale, the needle moving either to the left or to the right, according to the direction of the current.

The arrangement of Fig. 2 has the advantage over that of Fig. 1, in that it employs two end-cell regulators, one for charging, the other for discharging; and it is obvious that the lights can be fed at constant voltage from the storage battery at the same time the latter is being charged.

Fig. 3 shows a case where the generator supplies current at constant voltage at the bus-bars, and at the same time may be charging the accumulators, the higher voltage necessary being obtained from a booster dynamo working in series with the generator. By means of the double-throw switch, O_1, the storage battery may be charged or made to discharge in multiple with the generators.

Fig. 4 shows the application of Fig. 2 with the addition of the booster dynamo with the same advantages over Fig. 3 as Fig. 2 has over Fig. 1.

In Fig. 5 the booster dynamo is driven by an electric motor, and it is of interest to note the shunts and rheostat connections of the same. Only one rheostat is employed for both machines. If it is desired to raise the voltage of the booster dynamo, the rheostat lever is moved in the direction which inserts more resistance in the motor shunt, and less in the dynamo shunt. Thus, the voltage is raised both by the increase of speed of the motor and by the greater exciting current of the dynamo. This method is, however, not always employed, preference being frequently given to the connections, as shown in Fig. 11. Here the booster voltage is automatically raised as the charging proceeds and the voltage of the accumulators increases. R_2 is the starting rheostat for the motor.

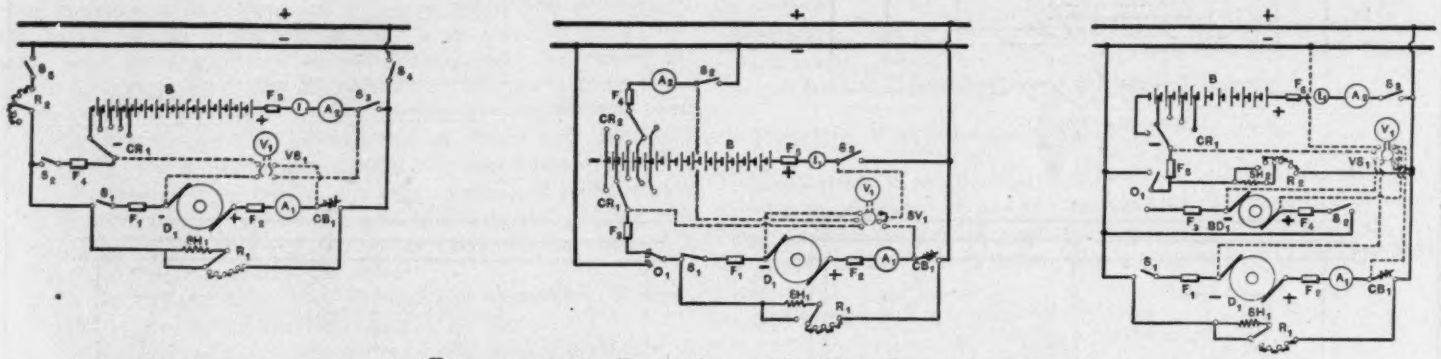
It sometimes happens that it is decided to install a storage battery after the generators have been installed, and that the latter, with their shunt rheostats are therefore not designed to give the necessary higher voltage for charging and that the expense of extra boosters is undesired, or is not warranted. Then the battery may be charged by dividing it into two sections and charging them in parallel, as shown in Fig. 6. R, R are resistances necessary to "kill" a certain predeterminable amount of voltage through the entire charge.

Fig. 13 shows the same diagram as applied to a three-wire system; in this case it is impossible to supply energy for lighting purposes during the time of charging because of the absence of the potential divider. Hence when charging it is necessary to open the switches S_1, S_2.

Fig. 7 shows Fig. 2 as applied to a three-wire system, and Fig. 9 shows a similar diagram, except that the generators are connected to the outer mains and develop twice the lamp voltage.

Figs. 8, 10, 11 and 12 show various methods of applying motor-driven boosters to three-wire systems.

Of all these diagrams Fig. 10 is the most general in use, for it combines the greatest simplicity with the greatest flexibility. Uninterrupted service can be given both from the generators and storage battery during the charging. There is only one booster, but each battery half may be separately charged, which becomes necessary from time to time, or the whole battery may be charged in series. In this diagram O_1 and O_2 are three-point switches. When O_1 is at a and O_2 at c the right hand battery may be separately charged; if O_1 is at b and O_2 at d then the left hand battery. To charge both right and left hand batteries simultaneously, switch O_1 to b and O_2 to c.



FIGS. 1, 2 AND 3.—DIAGRAMS FOR TWO-WIRE SYSTEMS.

It is to be noted that in Fig. 11, with the generators connected to the outer mains, the motor driving the booster must receive its energy from the opposite battery half of that on which that booster is working. Otherwise it is impossible to charge each half separately. In Fig. 8 this arrangement is, of course, not necessary, as the motor receives its energy from the generator.

Fig. 12 shows the booster dynamo driven by two motors, all three machines being mounted on a common shaft. The motors, in addition to driving the booster dynamos, act as equalizers. If there is perfect equilibrium in the two circuits then they run as motors, but if one circuit has a higher potential than the other, then the corresponding machine drives the other motor as a dynamo, adding po-

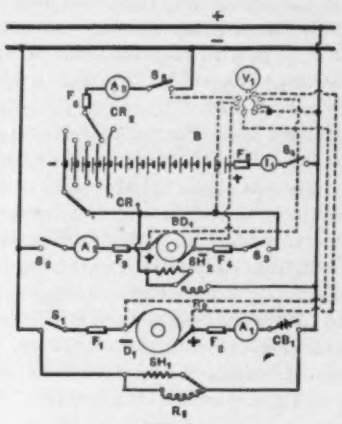


FIG. 4.

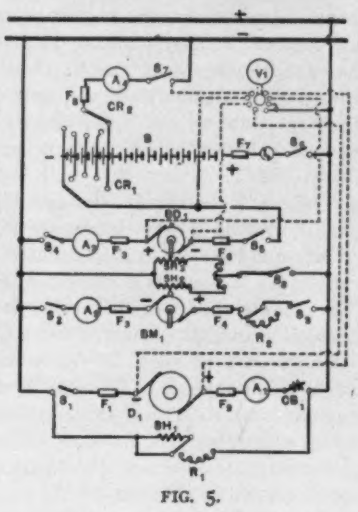


FIG. 5.

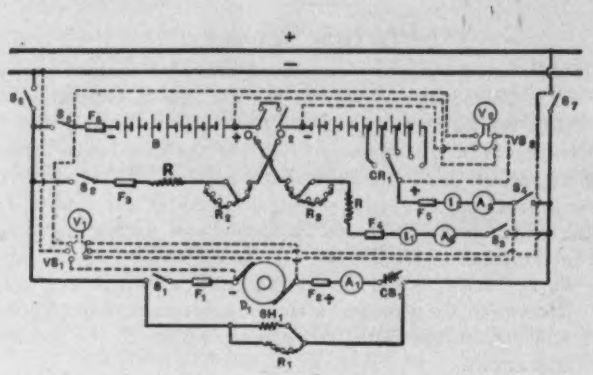


FIG. 6.

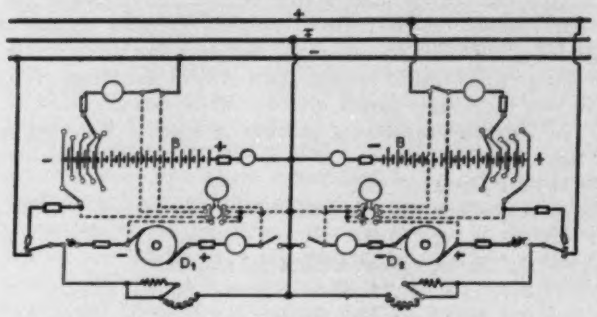


FIG. 7.

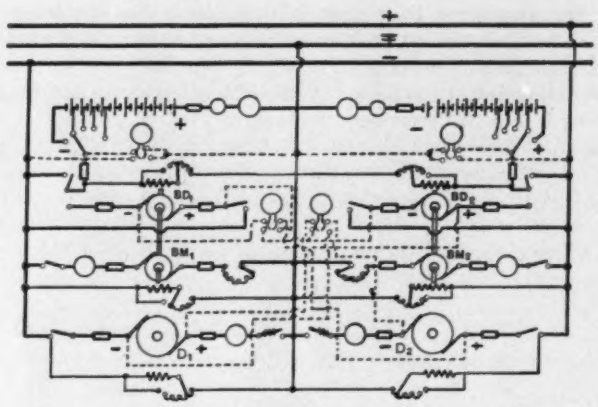


FIG. 8.

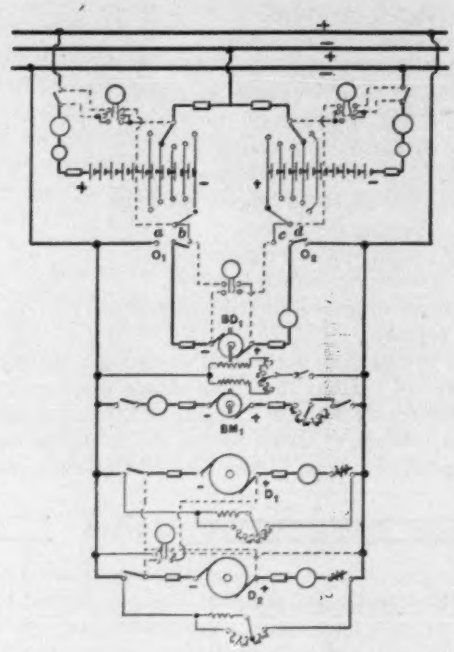


FIG. 10.

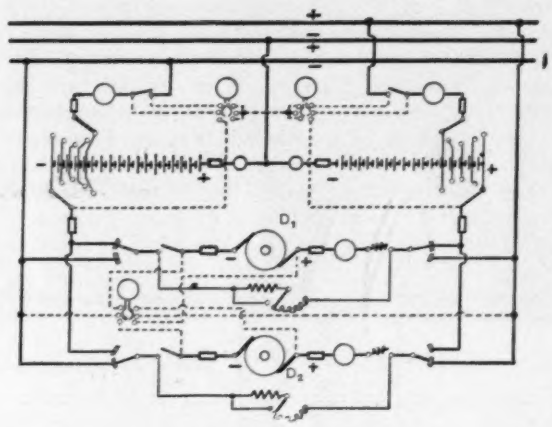


FIG. 9.

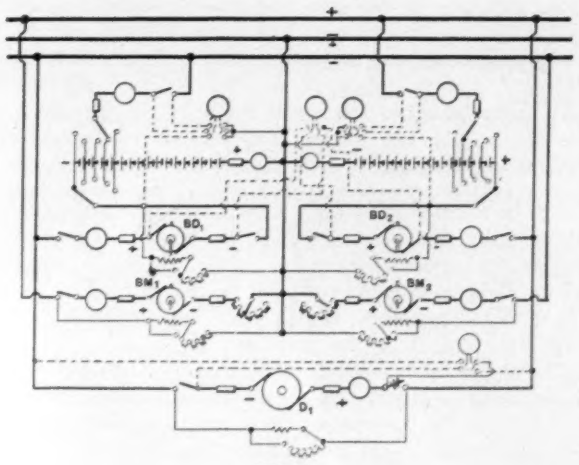


FIG. 11.

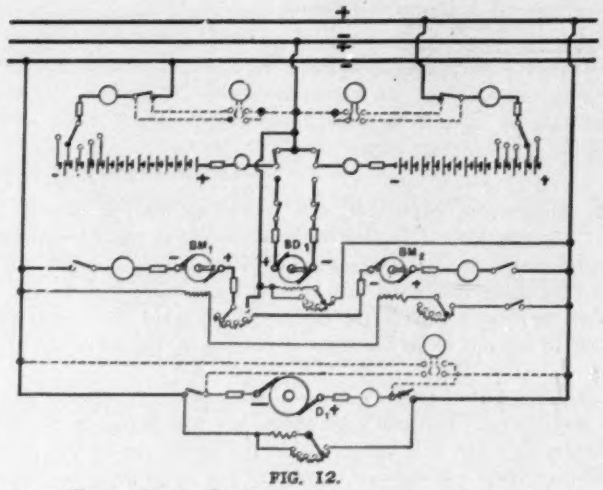


FIG. 12.

FIGS. 4 TO 12.—DIAGRAMS OF TWO-WIRE AND THREE-WIRE SYSTEMS.

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tential to the other circuit, and at the same time reducing the potential of its own by taking energy from it. The motors are started by connecting them in series to the outer mains. The starting rheostat is so designed that the neutral wire is only connected after the last resistance is cut out. The field magnets of the motors are connected in series to the outer mains. It will be seen that the field windings of the generators are all shown connected to the bus-bars. This is considered better practice than to connect them across the brushes, be-

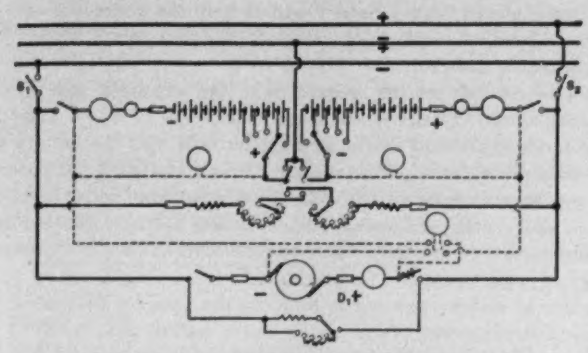


FIG. 13.—DIAGRAM FOR THREE-WIRE SYSTEM.

cause in the first place when suddenly breaking a heavy load, no undue strain on the insulation is produced through the otherwise usual kick in voltage, and secondly, because the generators can be brought up much quicker to their working voltage than would be the case if they have to develop their own exciting current.

It is, of course, desired that the shunt windings be cut off the circuit when the generators are not working, and the preference is given to short-circuiting rather than to open circuiting the field magnets, as shown in the diagrams.

All circuit generators are supplied with a single-pole under-load circuit breaker to protect them from the possibility of the battery current reversing into them.

Storage Battery Auxiliaries—V.

By LAMAR LYNDON.

CONSTANT CURRENT BOOSTER.

The regulating boosters before described—the compound and the differential—are adapted to systems where the lines are long and line drop is high, as they maintain the line voltage at normal at the point of their connection to the circuit, whatever the external load may be.

In systems where the lines are short and the drop small, it is often desirable to have the e. m. f. fall on application of overload. The reason of this is that the overload is produced by the current rush due to starting of motors, and if the e. m. f. be lowered the motors start more easily and the accelerating current is decreased.

This condition prevails in buildings where elevator, printing press and other motors are used, which frequently start and stop. For such systems the constant-current booster is best adapted, and it is now sometimes used on railway and other circuits of a like nature, being installed instead of the compound or differential. Of this type of booster there are only two kinds—one being the invention of J. B. Entz, and the other that of the writer.

Patent No. 625,100, dated May 16, 1899, and issued to J. B. Entz, covers the system shown diagrammatically in Fig. 12.

In the diagram, G is the generator, B the booster armature, E battery, C series coil, f shunt coil, S_1 switch short-circuiting series coil, f shunt coil, R rheostat, $\times$, $\times$, $\times$, non-fluctuating load requiring constant potential, M M fluctuating load, and L L^1 the mains.

It is to be noted that all current used in the fluctuating load must pass through the series coil and armature, and that there is never a reversal of current in the booster; also that the voltage impressed on the fluctuating load is greater than that on the non-fluctuating load by an amount equal to the booster voltage.

The shunt coil creates an e. m. f. in the same direction as the generator e. m. f. The series coil opposes the shunt and generator e. m. f.

Should a load come on the power circuit, the generator tends to send additional current through the booster to meet this demand. The action of increased current is, however, to cut down the e. m. f. of the booster in a direct proportion, causing the generator with the booster to give an e. m. f. that varies inversely as the resistance of the power circuit, thus causing under any condition—up to full battery charge—a constant-current delivery from the generator.

On systems where the battery serves for regulation only and the charges and discharges are not widely different in amount, the booster carries only the *average* current and not the maximum of the fluctuations, as is the case with the series, compound and differential systems. The machine and its driving motor may therefore be considerably smaller than would be required if those types were used.

Following is an analytical discussion of the constant-current booster:

E_M = maximum generator voltage.

Let E_0 = normal line voltage on generator side of booster.

E_A = normal battery voltage.

E_x = battery voltage at any condition of charge.

E_B = booster voltage.

V = voltage due to shunt coil at normal battery voltage.

t = number of turns in series field.

I_x = generator current to power.

I_0 = current in external load.

R = resistance of battery circuit.

r = resistance of booster armature and series field.

K = volts produced per ampere turn on booster field.

N = number of cells in series.

h = volts drop at generator per ampere of generator current.

The minimum battery voltage should be the same as the generator voltage, as it is often desirable to connect the battery on to the

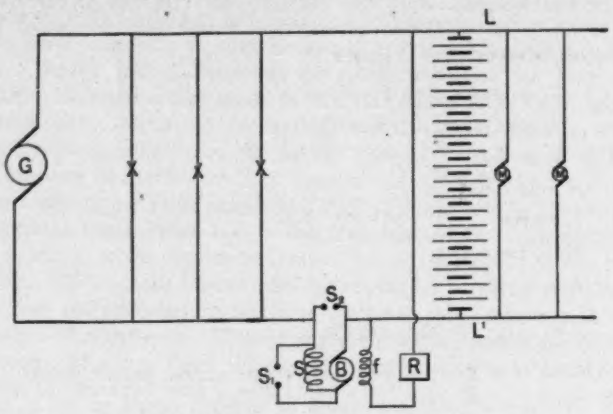


FIG. 12.—DIAGRAM OF ENTZ SYSTEM.

generator circuit by closing S_2, and supply the lighting current for short periods during which the generator is shut down and disconnected from the circuit.

Therefore, $N = \frac{E_0}{1.8}$

The battery is installed with some of the cells on one end connected to points on an end-cell switch, and so arranged that when connected on the lighting load and discharging only, these cells can be cut in as the voltage drops. This arrangement will be explained later.

The number of end cells required are

$$N - \frac{E_0}{2.3} = \frac{E_0}{1.8} - \frac{E_0}{2.3} = .121\ E_0$$

The maximum voltage of battery, and consequently across the power bus-bars, is 2.5 N. The average voltage will be $2 \times N$. The voltage due to the shunt coil will, for purposes of calculation, be assumed as equal to the difference between the generator voltage and the maximum battery voltage, or $2.5\ N - E_0$.

When the outside load is normal and the battery is at normal voltage, the booster e. m. f. $= E_A - E_0 + r\ I_x$ (24)

and current flows neither into nor out of the battery. Therefore,

$$V - t\ I_x\ K = E_A - E_0 + r\ I_x \quad (25)$$

whence

$$t = \frac{V - E_A + E_0 - r\ I_x}{I_x\ K} \quad (26)$$

This assumes a constant permeability. Knowing V_1, E_A, E_0, K, r and also the average load or I_x, t is determined. Remembering that the voltage of the shunt coil will vary directly as the voltage of the battery to which it is connected, its e. m. f. for any battery voltage will be

$$\frac{V E_x - V R I_0 + V R I_x}{E_A}$$

For any external load or battery voltage, the following is the equation of e. m.'s f.:

$$\frac{V E_x - V R I_0 + V R I_x}{E_A} - I_x t K - I_x r - I_x h + E_0 - E_x = R (I_x - I_0) \quad (27)$$

whence

$$I_x = \frac{E_0 + \frac{V E_x}{E_A} - E_x + I_0 \left(R - \frac{V R}{E_A}\right)}{t K + r + R - \frac{V R}{E_A} + h} \quad (28)$$

Since for any given condition of battery, all the factors in equation (28) are constant, except I_0, the generator load varies with the external load. It is evident that the higher V is made the better the regulation will be.

If the shunt coil be connected across the bus-bars on the generator side, V will be a constant and equation (27) will become

$$V - I_x h - I_x t K - I_x r + E_0 - E_x = R I_x - R I_0 \quad (29)$$

and

$$I_x = \frac{E_0 + V - E_x + I_0 R}{t K + r + R + h} \quad (30)$$

This shows that the regulation is better with the shunt coil connected across the battery terminals.

The following example will illustrate the methods of calculation:

Assume a 125-volt, two-wire system furnishing current to lights and electric elevators. Assume

I_x average = 50 amperes.

I_0 maximum = 300 amperes.

$r = .2$ ohm.

$R = .2$ ohm.

$K = .02$.

$E_0 = 125$ volts.

$h = 0$.

$N = \frac{125}{1.8} = 69.6$, say 70

$E_A = N \times 2 = 140$ volts = voltage across power mains.

Number of cells connected to end-cell switch = $.121 E_0 = 14.7$, say, 15.

$E_{A'max} = 2.5 \times 70 = 175$ volts.

$E_{A\,min} = 70 \times 1.8 = 126$ volts.

Range of voltage through which motors operate = 49 volts.

Assume $V = 100$ volts.

Then $t = \frac{100 + 125 - 140 - .2 \times 50}{50 \times .02} = 75$ turns.

Assume $I_0 = O$. Then

$$I_x = \frac{100 + 125 - 140}{75 \times .02 + .2 + .2 - \frac{100 \times .2}{140}} = 48.4 \text{ amperes.}$$

If $I_0 = 50$ amperes,

$$I_x = \frac{85 + 50 \left(.2 - \frac{.2 \times 100}{140}\right)}{1.756} = 50 \text{ amperes; and for } I_0 = 300, I_x = 57.8 \text{ amperes.}$$

The minimum generator current will be when the battery is at its maximum voltage, and

$I_0 = O$. Then $I_x = \frac{100 + 125 - 175}{1.756} = 28.5$ amperes.

I_x is a maximum when E_A is a minimum, and $I_0 = 300$. Then

$$I_x = \frac{100 + 125 - 126 + 300\ (.0572)}{1.756} = 65.8 \text{ amperes.}$$

Proper attention to the rheostat should prevent I_x from ever rising so high. If V were 50 volts, I_x would be 42.2 amperes for $I_0 = O$, and 88.5 amperes for $I_0 = 300$ amperes with E_A normal. With $E_A = 126$ volts and $I_0 = 300$, $I_x = 105.4$ amperes.

V then is determined by the regulation desired. The higher V is the better the regulation, but the size of the machine increases with increase of V.

While the generator current varies with any variation of E_A, the latter changes gradually, and does not cause any sudden fluctuation. If the battery is used only for regulation, its e. m. f. will vary but little; but if used to carry light loads or help the generator carry the peak of the load, E_A will vary from 2.5 N down to 1.8 N, and rheostatic control is desirable.

The size of the booster required in the example just given is maximum shunt voltage × armature capacity. If V be sufficiently high to send 10 per cent of the average current into the battery when E_A is maximum, it is great enough for all charging purposes. V maximum therefore never exceeds V. In the case under consideration, $I_{x\,max} = 68.5$ amperes, and $V = 100$ volts. The booster is therefore a 6.85-kw machine; 70 per cent of this, or 5 kilowatts, will be large enough to make this machine.

The size of motor required is fixed by the product of booster volts multiplied by amperes taken at the same instant and when at their maximum. This is when the maximum load is on and E_A is a minimum. In this case the booster voltage is 46.2 and current is 65.8 amperes. But the voltage is negative, opposing the generator e. m. f., and the booster is therefore acting as a motor.

The maximum positive volts multiplied by amperes is when the series field is short circuited by closing S_1 (See Fig. 11), and a charging current is being sent into the battery, and E_A is maximum. If this current = 50 amperes, $E_A = 175$; booster voltage = $E_A - E_0 = 50$. Therefore, the size of the motor is 2.5 kilowatts.

Improvement in the Metallurgy of Aluminum.

BY CLINTON PAUL TOWNSEND.

THE commercial process whereby all aluminum is now produced, known in this country by the name of Hall, and in Europe by that of Héroult, has remained without substantial modification for more than a decade. Bauxite, the crude native hydrate of aluminum, is purified by a laborious process involving its fusion with sodium carbonate, solution in water of the aluminate so formed, filtration, and precipitation of aluminum hydroxid from the filtered solution; this precipitate is then calcined, dissolved in a molten bath of mixed fluorids, and electrolyzed.

Crude bauxite, as mined in Georgia and Alabama, contains, in addition to hydrous alumina, oxides of silicon, iron and titanium, and is worth about $2.71 per metric ton (1899). On the other hand Roberts-Austen has estimated that the cost of the purified alumina constitutes 45 per cent of the expense of the production of aluminum. As two pounds of alumina suffice for the production of one pound of the metal, the discrepancy between the above figures will sufficiently indicate the costly character of the present purification methods. Furthermore, the procedure outlined is objectionable by reason of the practical impossibility of freeing alumina so obtained from the sodium carbonate employed for the initial fusion.

It has been heretofore proposed to dissolve the crude bauxite in the fluorid bath employed in the regular working and to purify it therein by fractional electrolysis, the current employed being sufficient to precipitate in metallic form the contained silicon, iron and titanium, but without the deposition of notable quantities of aluminum. This procedure has not been successful, for the same reasons that have prevented the use of fractional electrolytic methods generally; the voltage requisite for the separation of the impurities is so close to that needed for the principal metal that after the purification has proceeded to a very limited extent, all constituents of the bath are thrown down together.

The electric furnace methods for the purification of bauxite now disclosed by Mr. Chas. M. Hall, of Niagara Falls, and covered by three patents of recent date (June 25), are of the highest interest and should considerably reduce the cost of aluminum of certain grades. Hall's product differs entirely from pure alumina as heretofore known, both in appearance and properties, and cannot properly be designated by this name. It is a grayish-white crystalline body of vitreous lustre, having a specific gravity of 3.70 to 3.93, or intermediate between that of the calcined aluminum hydrate and that of alumina crystallized from fusion, and corresponding approximately

to the minimum specific gravity of the mineral corundum. In structure the fully treated product resembles a coarse sandstone, being coherent but readily crushed, and even friable between the fingers. It has a peculiar odor suggestive of the hydrocarbons and is partially soluble in hydrochloric acid and in caustic alkalis with liberation of methane (CH_4) and hydrogen. The former gas indicates the presence of aluminum carbid, and the latter is attributed by the inventor to the presence of a suboxid of aluminum having the formula Al_3O_4. The product, after being freed from any iron, exerts a reducing action upon acid solutions of potassium permanganate, showing that it is capable of undergoing further oxidation, and this is borne out by the observation that it gains weight by prolonged ignition in air, especially if preliminarily moistened with nitric acid. Analyses show a percentage of aluminum somewhat higher than corresponds to the formula Al_3O_4.

This remarkable product results from either one of two processes, covered by separate patents bearing the same date. The first of these is described with reference to a bauxite of the following composition:

Alumina	60 %
Ferric oxid	18 "
Silica	2—3 "
Titanic oxid	3—4 "
Water	17 "

After calcination, which may be in presence of carbon, the material is mixed with 8 to 10 per cent of carbon, and held in fusion for about an hour in an electric furnace having a lining and an electrode of carbon, the current being either alternating or direct. Under these conditions no aluminum is separated, for, as was shown some years ago by Moissan (*Comtes Rendus* 119, p. 935) molten alumina may be maintained in contact with carbon for considerable periods without reaction, and reduction occurs only when both oxid and carbon are in a state of vapor. The contained impurities, however, become reduced, and, especially in the presence of considerable amounts of iron, settle to the bottom of the bath as a fused alloy. When the iron content of the bauxite is low, or when it runs high in silica and titanic oxid, it is found advisable to add more iron, either as metal or oxid, to facilitate this separation.

The second method bears a close relation to that just described, but substitutes, in whole or in part, for the carbon employed as a reducing agent, metallic aluminum. This metal is added in quantity sufficient to combine with the whole of the oxygen of the silica, titanic acid and iron oxid known to be present, and the bath is maintained in fusion in the above described electric furnace for 1½ hours, after which time the foreign metals are found to have separated out as before, the added aluminum passing, of course, into the state of oxid without evolution of gas or disturbance of the quiet fusion. Here again it is important that sufficient iron be present to take up the silicon and titanium, and this is conveniently accomplished by adding, instead of pure aluminum, a readily comminuted ferro-aluminum containing about 50 per cent of each component.

It is to be inferred from the specifications that while the elimination of silicon and iron is practically complete, titanium has proven more refractory; indeed this is to be expected. The presence of titanium in small amounts in aluminum is rather advantageous than otherwise as regards its structural uses, but may limit its applicability in other directions; the question is an important one by reason of the peculiarly constant occurrence of titanic acid in American bauxites.

As has been said, Mr. Hall refers to the probable presence in his product of a suboxid of aluminum of the formula Al_3O_4. It would seem decidedly more probable that the excess of aluminum noted in the analyses, as well as the liberation of hydrogen from solvents, is attributable to the presence of the oxid Al_2O, first obtained by Pionchon (*Comptes Rendus* 117, p. 328) as a gray-black coating resulting from the incomplete oxidation of aluminum, and recently produced by Duboin (*ibid.* 132, p. 826), by what is probably the very reaction which occurs in the second of the above described processes—reduction by aluminum of the oxid Al_2O_3.

Certain processes heretofore patented abroad, for the manufacture of abrasives by the fusion of native emery in the arc in presence of carbon in quantity sufficient to eliminate the iron, bear a superficial resemblance to the first of these patented methods; but the resemblance is apparent only, since the raw materials differ in kind, the processes in the duration of the treatment, and the products in all essential characters.

The Nernst Glower Applied to Electric Furnaces.

The second United States patent granted for an application of the Nernst glower principle to an electric furnace, appears in the issue of June 25, having been issued to Arthur H. Eddy, of Windsor, Conn. This furnace is designed particularly for the fusion of enamels upon any of the usual earthenware or metallic bases, and consists of a series of tubes of such materials as are now known to conduct electrolytically at high temperatures. Within these tubes, but out of contact with their walls, are resistance rods of carbon, the ends of these rods, as well as of the tubes, being supported in appropriately formed water cooled metal clamps, which serve also as electrical connectors. The current, when the circuit is first closed, traverses the carbons, but as the tubular envelopes become heated a portion of the current is shunted through them, and in further work the carbons may be entirely withdrawn. It is proposed to construct a single pair of clamps to carry a number of tubular heaters, each with its interior carbon, the current passing in parallel through the group; a plurality of these groups, differing only in the number of units comprised in them, are then connected electrically in series, and arranged side by side, transversely, above a long narrow furnace hearth, in such manner that the articles to be heated, in passing along the hearth beneath the tubes, will be subjected to varying degrees of heat. If, for instance, it is desired to provide a furnace chamber wherein the temperature falls in either direction from a central point, as is common in annealing leers, the result is accomplished by progressively increasing the number of units in the series-connected groups in each direction from the center, and providing means for causing the articles to traverse the furnace from end to end at a definite rate.

The only other domestic patent for a furnace involving this principle was granted a year ago to H. N. Potter, of Göttingen. In form this furnace is merely a tube composed of a mixture of oxides, as magnesia and yttria or zirconia and yttria, provided at its ends with electrical connections, and enclosed, for considerations of strength, in a heavy jacket consisting of either one—but not both—of the oxides composing the inner tube. The whole is surrounded by the preliminary heater, in form a wire coil wound directly upon the jacket or upon an enclosing sleeve of talcite. As is well understood, a mixture of oxides or "dry electrolytes" is a far better conductor than any single pure component oxide; consequently the inner tube conducts the current and is the true seat of the high temperature developed, while the outer jacket, of an unmixed oxide, remains practically non-conductive, and by reason of its close chemical relation to the composition forming the inner tube, supports it without danger of fluxing it. If these dry electrolytic heaters are to be constructed of a size fitted for electric furnace work they must in most cases be provided with a suitable support extending over their entire length, and for this purpose the pure oxide, as suggested by Potter, would seem to be the only practicable material, all other refractory substances being either conductors or else capable of uniting chemically with the electrolytic oxides at the high temperature developed, with the formation of relatively fusible compounds.

Potter's furnace is designed especially for baking rod or tube shaped glowers for Nernst lamps, and provides for this purpose an even heat which will neither distort nor crack the glower. Eddy's furnace, as stated, is intended for enameler's use. It is for such purposes as these, where the temperature must be susceptible of minute regulation, and the furnace chamber entirely free from vapors of carbon and from the ash arising from its combustion, that these devices will find application. They would seem especially suitable for dental muffles, a class of furnaces requiring very high temperatures, and at the same time and in the very highest degree, cleanliness and ease of control.

To Arbitrate on Electric System.

A London dispatch states that at a meeting of the Parliamentary Committee on June 28 it was "decided that the Board of Trade should be asked to appoint an arbitrator to report as to whether the Ganz or the Yerkes electric system be employed on the old underground railway. It was also decided that the Board of Trade should give an official decision on the referee's report unless the officers of the Metropolitan District Railway agree upon a mode of traction within two months." This dispatch is not very clear, as the Ganz system is understood to have been rejected, and Mr. Yerkes is not the proprietor of any system, but the chief owner of the road.

Convention of the Northwestern Electrical Association

THE Northwestern Electrical Association held its summer convention at Sheboygan, Wis., June 26, 27 and 28, 1901. The headquarters were at the Lake View Beach Hotel, a summer resort on a line of the Sheboygan Light, Power & Railway Company, beautifully situated on a high bluff overlooking Lake Michigan, and about two miles from the center of town. The place selected and entertainment provided were excellent, but the attendance, especially of central station men, around whom the association is formed, was disappointingly and almost ridiculously small; as a result of which it seems now altogether likely that the summer convention of the Association will be abandoned, and the effort concentrated on the winter meetings, which have always been the most successful.

The first session was called to order at 10 o'clock Wednesday morning, June 26, by President E. L. Debell, of Sheboygan, who extended an informal welcome to the supply men present. The following new members were then elected: Delevan Light & Fuel Company, Edwin Schuette, Christensen Engineering Company, and Pass & Seymour.

Secretary Thomas R. Mercein, of Milwaukee, then read the report of the special committee appointed to investigate and report on "Gasoline Lighting," and its effect on the central station interests in the Association's territory. The report stated that inquiries were sent out covering every central station plant in the States of Michigan, Wisconsin, Iowa, Minnesota, North Dakota and South Dakota. Out of 370 inquiries sent out 160 replies were received in time to enter on the report. The number of plants reporting customers lost is 75, the principal of which are as follows: Council Bluffs, Iowa, 25 customers lost on account of gasoline plants; Missouri Valley, Iowa, 25; Lead, S. Dak., 10; Grinnell, Iowa, 12; Clarinda, Iowa, 12; Nevada, Iowa, 10; Mankato, Minn., 20; Marinette, Wis., 15; Tipton, Iowa, 13; Corning, Iowa, 12; Creston, Iowa, 50. Many other stations reported losing 5 to 10. Many report that customers come back after trying gasoline, so the net loss of actual customers in the district covered is remarkably small.

Reports show many different kinds of gasoline lamps and plants; some towns having 8 to 10. The most common are the hanging lamps, gravity burning and air pressure systems, with tanks or generators in the basement. An underwriter's list of approved gasoline devices was attached to the report. The underwriters lay great stress on the danger of all these lamps, but pass 40 kinds as safe. The moral is apparent. In only five cities are gasoline street lights reported. Minneapolis has 1500; St. Paul, 3000; Dubuque, Iowa, 100; Des Moines, Iowa, 100; Winona, Minn., 70. In the small towns they do not seem to be used at all for street lights. There is hardly a report that does not mention one or more accidents resulting from leaks or explosions of gasoline lamps.

Mention was made of a pamphlet published by the Illuminating Publishing Company of Cincinnati, entitled, "Is the Use of Gasoline and Acetylene Dangerous to Human Life," which contains a ghastly record of lives lost. The users of gasoline lamps seem, from the reports, to be mostly small merchants, barbers, grocers, saloons, restaurants and drug stores. It seemed to the committee that a proper discount to long-hour users would retain many of those who look to gasoline to keep down expenses, though many gasoline users are the undesirable class of customers that are always looking for something for nothing. The larger stores usually put in pressure tank plants and from the reports they are very short-lived, because of poor regulation, heavy cost of mantels and glassware.

The cities of Oelwein, Iowa; Lead, South Dakota; Marengo, Iowa; Corning, Iowa; Ouatonna, Minn.; Creston, Iowa; What Cheer, Iowa; Spencer, Iowa; Tipton, Iowa; Tecumsah, Mich.; Montevideo, Minn.; St. Paul, Minn., and Monroe, Wis., all report that the competition is serious. The other 90 per cent of the companies heard from do not consider the competition serious. They think that the people that use gasoline do not get satisfaction, and that they are not a permanent success. A certain percentage of people are always trying new things, and of course there will always be many lamps and machines that will look as if they might threaten the electric and gas plants. The general result is that where good service with gas or electricity is to be had at reasonable prices the gasoline lamp will only be used by the few kickers and cheap people that are to be found in all communities. Many companies report that nearly all the customers who experimented with gasoline have gone back to electricity. A few places report insurance rates as raised on gasoline lamp users. Most of the reports would indicate that there is no objection at all. If one agent objects, another, owing to the competition, stands ready to take risks at the old rate. The opinion of the Committee is that gasoline lighting plants, being recognized as very unsafe and dangerous, should be rigidly prohibited, not because of the competition they give in some cases, but because they are unsafe, dangerous to an extreme, and a source of danger to people on each side of them or above them, who do not use them.

In conclusion, says the committee, it would seem from these reports that each town has lost from a few to a large number of customers by reason of gasoline competition, but that most of these people have returned to the use of electricity, showing that while it may be a very cheap light, there must be great drawbacks to its general use. There are in every town lots of people looking for something for nothing, and the gasoline idea is a smooth one and catches their fancy. They do not know the origin of the fluid, its quick evaporation on exposure to the air, and its consequent danger; and it is only by actual experiment that they become convinced that it is no good, and usually after paying $150 or more for an outfit that cost about $25. "Of course it will not do to lose sight of this fact, that where many minds and much money is concentrated on one object that is it more than likely that some day a perfect gasoline lamp will be invented, and we must be on our guard and hold our customers by giving good service and good rates. But at present it is evident that it does not seriously threaten our interests." The report was signed by S. B. Livermore, chairman of the committee.

After the reading of the committee's report a communication was read from the International Association of Municipal Electricians asking members of the Northwestern Electrical Association to so time their Pan-American visits as to attend the convention of Municipal Electricians at Niagara Falls, September 2, 3 and 4. After transacting some routine business the convention adjourned until 2 p. m.

The Wednesday afternoon session was concluded by the reading of a paper on "Trades Training for Non-Technically Educated Men," by Prof. B. V. Swenson, of the University of Wisconsin.

The object of this paper was to call special attention to the short summer courses along this line recently established by the University of Wisconsin. This is known as the School for Apprentices and Artisans, and opens July 1, 1901, to continue six weeks. The plan of the school, which originated with Dean B. J. Johnson, has been worked out and will be carried on under the direction of the College of Engineering. The school, while bearing some relation in its courses of study to correspondence schools, is not in opposition, but should rather be considered as supplementary to them. At the School for Apprentices and Artisans those having acquired by correspondence or otherwise the theory of certain lines of practice, can spend their entire time in the shops or laboratories if they choose, and so put into practice and prove experimentally the scientific principles learned from books or by correspondence.

The school has been established for the benefit of machinists, carpenters, sheet metal workers and electricians; stationary, marine and locomotive engine men; shop foremen and superintendents; superintendents of water works, electric light and gas plants, power stations, factories and large office and store buildings; for business men interested in technical affairs, and for young men who wish to qualify themselves for such positions. For these employments the full four years professional courses in engineering are not required, and yet to satisfy the present demand on this class of men it is necessary for them to obtain a certain amount of technical knowledge. In the case of apprentices the purpose of the school is to give them a theoretical and practical instruction in the line of their trade, which they would not get in the shops, but it is not the purpose of the school to give the shop practice which they are expected to receive in serving their apprenticeship.

The machine trades lie at the basis of all manufacturing, and superiority in these very largely sustains our modern prosperity. The practical abandonment of the apprenticeship system also, as a result of the very general adoption of labor-saving machinery, and the common practice of confining a workman to the operation of a single type of machine, leaves our young men with no means of acquiring that wide and thorough knowledge of the machinists trade which formerly they could obtain in the workshops by a long aprenticeship. For these reasons some new kind of industrial education becomes imperative. Some examples may serve to illustrate the advantages to be derived in special cases.

Detailed information on the ground covered by the six weeks' course of study was included in the paper, all of which can be obtained by application to the university authorities.

Thursday morning the convention was opened by the reading of an invitation to the members of the Association to attend an electrical exposition to be held in Milwaukee, Sept. 7 to 28, 1901, the invitation being signed by Chas. G. Armstrong.

Prof. Dugald C. Jackson was voted an honorary member of the Association.

The Efficiency Curve of a Shunt Motor and Its Relation to Operating Characteristics and the Cost of Operation.

The first part of a paper with the above title, read by Prof. Budd Frankenfeld at the Sheboygan convention of the Northwestern Electrical Association, was devoted to an investigation of the factors entering into efficiency, and the conclusion is established that the maximum efficiency is reached when the loss varying as the square of the armature current equals the fixed losses. After a study of the nature of the various losses, the method of testing for efficiency was outlined.

By far the most convenient and accurate method of testing efficiency is the stray power method. In this method the losses are measured after the machine has reached normal full-load temperature, and the efficiency curve is computed from the measured losses.

In making an acceptance test on any machine, it should first be submitted to a temperature run. This matter is so thoroughly covered by the rules of the American Institute of Electrical Engineers that nothing need be added as to requirements or methods. Before starting the temperature run, the motor should be adjusted for the best possible working conditions. The brushes should be properly set and fitted to the commutator and their tension adjusted for the least possible friction consistent with good commutation. Any necessary alignment of the bearings should also be attended to. This is but fair to the manufacturer.

Unless some means, such as a Prony brake, for measuring the power delivered by the motor is provided, the question as to just what the full-load current is will rise. This may be had from the manufacturer; absolute check on him will be obtained after the efficiency is calculated, and if there is any discrepancy a second temperature run may be made, using the corrected full-load current. Another method is to calculate the current from an assumed efficiency, and then make a second run at the corrected current. The motor may be loaded up either on an actual load or by some one of the three machine methods. In giving the method of test, it will perhaps make it clearer to follow out the steps in the test of a specific motor.

The motor is a four-pole, 110-volt, 5-hp machine, running at 1000 r. p. m. The full-load current is 41.5 amperes, of which 1.5 amperes is field current. It has been running for four hours at full load. and has been found to have reached a constant temperature, the thermometer on the field coils and the field current both having been steady for the last half hour.

The voltmeter across the terminals of the machine reads exactly 110 after correcting from the calibration curve of the instrument, and the corrected reading for the ammeter is exactly 1.5. The field loss is, therefore, $110 \times 1.5 = 165$ watts. Only the corrected readings are used in this test.

With a low-reading voltmeter tests are now made for loss in the lead wires of the machine and their contacts. The drop is found to be almost nothing, which speaks well for the design and workmanship. In this case the loss is so small that it may be neglected.

The motor is now shut down and a large water rheostat is placed in series with the armature. A low reading voltmeter, having a resistance of about 100 ohms per volt, is connected across segments that are under brushes of opposite polarity, the contact being made on the segments, not on the brushes. A current is now sent through the armature and readings of both voltmeter and ammeter obtained. This being a four-brush machine, voltmeter readings are taken under each pair of brushes. Four such readings are possible. This operation is repeated with five or six different currents, and the resistances found by dividing volts by amperes are computed and averaged. This average is 0.25 ohms. This same set of readings is necessary to compute the rise in temperature in the heating test.

The machine is now started up as a motor without belt or load. The voltage is adjusted to exactly 110, and it is found that the armature current is 2.42 amperes. The watts consumed by the armature are hence $100 \times 2.42 = 266.2$. Of this $2.42^2 \times 0.25 = 1.45$ watts are used up as I^2R loss. This leaves nearly 265 watts as the stray power.

The various components of the stray power can be separated out by a somewhat involved method, but this is a problem of more interest to the manufacturer than to the purchaser.

The low reading voltmeter is again called into requisition. It is provided with a pair of flexible cords terminating in stiff, pointed copper rods about 6 inches long. Arrangements having been previously made, the machine is shut down and started up as a separately excited dynamo without load. One of the copper points is held on a brush close to the commutator, the other on the commutator opposite the center of this brush. This central position is determined by shifting the latter point until the voltmeter reads zero. Full load current is now thrown on, care being taken not to change the position of the point. The voltmeter reading is found to be very unsteady, and a condenser of about one micro-farad capacity is then shunted across its terminals, the trial being made again. This time a fairly steady reading of 1.25 volts is obtained, and it is found to be about the same for all the brushes, and also for various loads, excepting at currents below four amperes, where it appears to be negligible. Thus no correction need be made for brush drop in the stray power measurements. The total brush drop is then $1.25 \times 2 = 2.5$ volts.

The efficiency curve of the machine may now be calculated. Assuming an armature current of 10 amperes, the total intake in current will be $10 + 1.5 = 11.5$ amperes, and the efficiency will be:

$$\frac{110 \times 11.5 - 265 - 165 - 10 \times 2.5 - 10^2 \times 0.25}{110 \times 11.5} = \frac{285}{1265} = 62.1\%$$

The rated output of the machine being 5 horse-power, or 3730 watts, the load at this assumed current will be $\frac{285}{3730} = 21$ per cent of full load.

The efficiency at any other current may be found in a similar manner, but the computation may be simplified by a graphical construction. In Fig. 1 the armature current is plotted along the horizontal line and the losses in watts vertically.

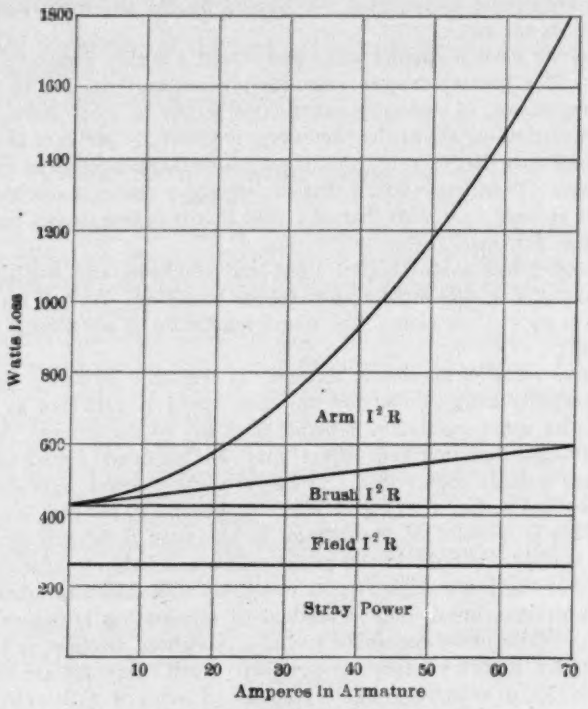


FIG. 1.—EFFICIENCY CURVES.

The first line from the bottom represents the 265 watts stray power; the next line above it is drawn at a distance representing 165 watts, the field loss. Both these losses are shown to remain the same regardless of the armature current. The other losses vary; the brush I^2R directly with the current, as shown by the slanting straight line, and the armature I^2R as the square, as represented by the distances between the slanting and curved lines. The distances between the slanting line and the upper curved line are calculated for several currents, their values being plotted and a curve thus drawn. The sum of all the losses at any assumed armature current can now be obtained by reading the vertical distance at that current from the base line to the upper curve.

An efficiency curve is thus calculated, and it is shown as efficiency curve, *I*, in Fig. 2.

SELECTION OF A MOTOR.

In order to bring out points in the selection of an electric motor, four machines of 5 horse-power each were designed and some of their

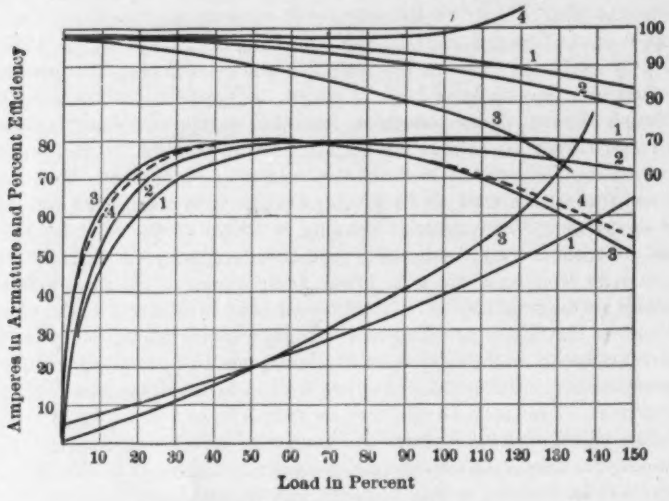


FIG 2.—EFFICIENCY CURVES.

characteristic curves plotted in Fig. 2. Only those features influenced by the form of the efficiency curve will be considered. Temperature and sparking limits are fully covered by the rules of the American Institute.

Motor 1 represents the average slow speed machine of a reputable manufacturer. Its maximum efficiency is reached at full load and is 80 per cent. The other motors have the same maximum efficiency. In 2 it occurs at three-quarter load and in 3 and 4 at half load. The speed regulation of machine 1 is shown by the curve marked 1 at the top of the cut.

Machine 2 has a smaller stray power and a higher armature resistance. The greater drop in volts for a given current, due to armature resistance, of necessity causes this motor to slow down more. Its regulation, as shown by the curve, is about 3.7 per cent lower at full load than that of 1, but this is not objectionable for most general purposes. It will be noticed that the efficiency curve is considerably higher at light load than that of 1, and that it is less than 1 per cent lower at full load.

Motor 3 has a still higher light-load efficiency and has the advantage of 1 in this respect up to 60 per cent load. At full load it is below 1 by 7.5 per cent. The speed regulation is something abominable.

Motor 4 has its maximum efficiency at the same load as 3, but it is differentially compounded for the same speed at full load as at no load. Its speed regulation is better than any of the others. A similar, though less marked, effect may be obtained by giving the brushes a large motor lead. It has a slightly lower light-load efficiency and a somewhat higher efficiency beyond 50 per cent load than 3. This is because of the change in magnetic flux with the load. This machine, if built in the ordinary way, is liable to spark under load, but there are designs that overcome this difficulty admirably. These designs involve some method of eliminating armature reactions. While more expensive to build, a lighter machine is the result and a higher efficiency is possible. Such machines are characterized by a relatively small amount of iron, a relatively large amount of copper on the armature and a small amount on the field. The curves, 4, really do not represent the commercial possibilities of this type.

One serious objection to a heavy differential compounding is the weak starting torque. A motor of this kind should not be used where a large starting torque is required. Another objection is the liability to reverse on a heavy over-load. This may be obviated by the use of a circuit breaker or a starting box having an over-load device. All motors should be so provided in any case.

The curves at the bottom of Fig. 2 show the armature current for different loads. Curve 1 applies to motor 1, and closely approximates motor 2. Curve 3 is plotted for motor 3 and closely approximates the performance of 4. At 50 per cent over-load machine No. 1 has the same current as 3 at 25 per cent over-load. This means that it will stand a heavier over-load than 3 for the same rise in temperature. No. 3 also requires 15 per cent more current at full load, but the current at light load is less.

The curve in Fig. 3 gives the cost of one horse-power at the pulley of a motor, for various efficiencies, the basis being 10 cents per kilowatt-hour. This price is taken merely for convenience. The correction for 12 cents would be obtained by multiplying by 1.2, for 8 cents by 9.8, and so on. It should be noticed how rapidly the cost increases as the efficiency drops off.

A comparison of the cost of operating motors 1, 2 and 3 will now be made on the basis of steady loads of several different values. The cost of operation is based on 10 cents per kilowatt-hour, and is figured for a working year of 300 days at 10 hours per day.

The accompanying table shows the cost at 25 per cent, 50 per cent, 75 per cent and 100 per cent load for each machine. It shows the advantage of working the motor at its point of maximum efficiency. A larger machine than the immediate needs demand is often installed in a small establishment on the faith of a growth in business. There is some reason in this. Motor 1, for instance, has an efficiency at half load of 76.7 per cent. It is doubtful if this could be beaten in a 2½-hp motor operating at full load.

Cost of operation of 5 horse-power motors, 10 hours per day, 300 days per year, at $0.10 per kilowatt-hour:

	25% *Load.*	50% *Load.*	75% *Load.*	100% *Load.*
No. 1	$426.50	$729.60	$1,054.80	$1,398.60
Less than No. 2	.....	.....	.....	15.90
Less than No. 3	.....	.....	24.30	146.40
No. 2	394.20	710.10	1,048.20	1,414.50
Less than No. 1	32.10	19.50	6.60	.....
Less than No. 3.....	.....	.....	30.90	130.50
No. 3	367.80	699.30	1,079.10	1,545.00
Less than No. 1	58.50	30.30	.....	.....
Less than No. 2	26.40	10.80	.....	.....

Motor 2 operating at half load will save $19.50 per year over 1; $6.60 per year at three-quarters load, and will lose $15.90 per year at

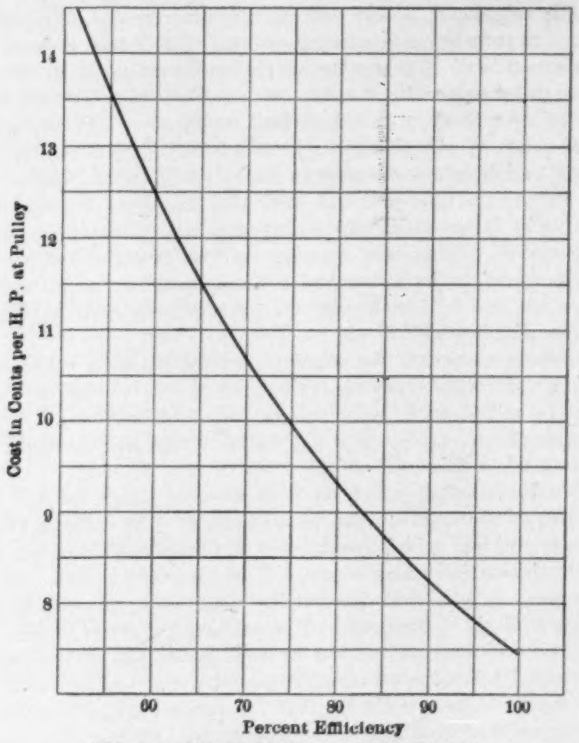


FIG. 3.—COST OF POWER AT THE PULLEY.

full load. In a term of eight years, 3 at half load, 1 at three-fourths load, and 4 at full load, the total cost of operation for machines 1 and 2 would be about the same; after that, if full load continued, 1 would be the cheaper machine. Where the future is in doubt, machine 2 is the better. It also saves $19.50 per year over a 2½ horse-power machine with a full-load efficiency of 76.7 per cent. A number of interesting comparisons of like nature can be made by a study of the table.

Let us now pass to the question of variable load. The following schedule is assumed:

4 hours at ¼ load.
2 " " ½ load.
2 " " ¾ load.
1 " " full load.
1 " " 1¼ load.

The average load is

$$\frac{4 \times 1.25 + 2 \times 2.5 + 2 \times 3.75 + 5 + 6.25}{10} = 2.475 \text{ H. P.}$$

This schedule may be taken as representing, roughly, the load in a small wood working shop, with a light running line shaft and several tools operating intermittently. The cost of operation for 300 days of 10 hours is as follows:

No. 1.— $1.25 \times 4 \times .1137^* = \$.5675$
$2.50 \times 2 \times .0973 = .4865$
$3.75 \times 2 \times .0937 = .7025$
$5.00 \times 1 \times .0933 = .4665$
$6.25 \times 1 \times .0941 = .5880$

2.8110
300

\$843.3000

No. 2 = ... 833.73
No. 3 = ... 875.55

Machine No. 1 is \$32.25 per year cheaper than No. 3, and 2 is cheaper than 1 and 3 by \$9.57 and \$41,82, respectively.

It is thus seen that the motor having its maximum efficiency at three-fourths load is the best all-round machine. This refutes the statement sometimes made that the maximum efficiency should occur at the average load; for 3 has its maximum at nearly average load, and is the most expensive to operate. Just where the maximum should occur depends upon the load schedule, and as this is seldom known and almost impossible to predetermine, it is at least safe to select a machine giving its maximum at about three-fourths load. Motor 2 meets these requirements. Its speed regulation is good enough for most purposes, and all other requirements can be easily met by the designer. Where absolute constancy of speed is demanded a differential compounding with some means for eliminating armature reactions should be employed.

Of course, there are all kinds of variable loads, and it is possible that under certain circumstances machine No. 3 may be the most economical. If direct connected to a tool where the load is light most of the time and full load is attained for an instant only, this motor would have a decided advantage. A heavy punch runs light excepting when the tool is being forced through the metal, and a planer requires a heavy current only during the moment of reversal. For such tools machine No. 3 is a suitable one. In some instances of this class it might even prove of advantage to compound it cumulatively, as close speed regulation is of no particular consequence.

The moral of this whole matter is to ascertain before hand the nature of the load and to specify the *value* and *position* of the point of maximum efficiency before purchasing a motor. ***It is useless to specify any more points in the case of a shunt motor.*** A large amount of data for getting the probable load is in the hands of manufacturers and consulting engineers. After purchase, the motor should be submitted to an acceptance test. Such tests are very commonly made where a large number of motors are installed under the direction of an engineer; but the average purchaser of a single motor usually buys "a motor" without knowing anything about it.

It is entirely possible that central station men would find it to their advantage to test motors free of charge for their small consumers, just as they have found it to their interest to test incandescent lamps and meters on request.

SUMMARY.

It should be borne in mind that most of the following conclusions apply particularly to small machines of not more than 15 horsepower capacity. Statements 11 and 12 are especially limited in this direction.

1. The point of maximum efficiency of a shunt motor occurs where the I^2R loss in the armature circuit (exclusive of brush I^2R loss) equals the sum of the fixed losses.

2. The earlier the maximum efficiency, the poorer the speed regulation.

*From efficiency curve and Figure 3.

3. An early maximum with excellent speed regulation may be obtained by a differential compounding.

4. Differential compounding, unless some device for eliminating armature reactions is employed, is likely to produce sparking.

5. If such device be used, a lighter machine of higher efficiency is possible. Its first cost will be higher.

6. A differential compounding should not be used where a great starting torque is desired, or where over-loads are likely to be heavy.

7. All motors should be protected with over-load devices for opening the circuit at a predetermined current.

8. In a shunt motor, the later the maximum efficiency, the greater the ability to withstand over-loads.

9. The cost of operation per horse-power hour, at the pulley, increases rapidly as the efficiency drops off.

10. Where the load is steady and always of the same value, a motor of a rating equal to the load should be used, the point of maximum efficiency being at full load.

11. If the load is steady but small, but is expected to increase due to growth of business, it might pay to install a machine of as high as double the immediate capacity. This does not hold for large units.

12. If the increased load is to come in a short time, say a year or two, the maximum efficiency should occur at full load; but if the time is distant and indefinite, but sure to come, the efficiency should reach a maximum at about three-fourths load.

13. For all-round service, where the load is subject to wide variations, the motor having its efficiency a maximum at about three-fourths load will give better economy than most of the present standard designs. Its speed regulation will not be so close, but still good enough for average shop purposes. The assertion sometimes made, that the maximum efficiency should occur at the average load, is not as a general statement correct.

14. In special work, such as the driving of metal planers and heavy punches, the maximum efficiency may be specified at as low as half load.

15. Ascertain the nature of the load before ordering the motor, then specify accordingly.

16. Test the machine before accepting it.

Incandescent Lamp Economy

A paper with this title was read at the recent Sheboygan Convention of the Northwestern Electrical Association, by Guy V. Williams, and as it possesses considerable practical value to the smaller central stations we abstract it quite fully.

During the past few years there has been but little choice in incandescent lamps insofar as initial claimed efficiency is concerned. 3.1, 3.5 and 4-watt lamps are offered; one chooses what appears best adapted for present needs, and takes what he gets.

An incandescent lamp is too often valued according to the number of lamp hours derived therefrom regardless of initial uniformity of candle-power, current consumption and candle-hours. Most of the prominent lamp makers may be depended upon to furnish initially satisfactory lamps, yet many lamps find their way to the market lacking in even this essential. A series of recent tests are presented to illustrate this.

Selected at random from a lot of 16-cp, 110-volt, 3.1-watt lamps and tested at their rated voltage:

17.0-cp.	50.0 watts
20.0 "	55.0 "
15.1 "	50.2 "
17.9 "	72.1 "
15.5 "	60.6 "

Average, 17.1-cp. 57.58 watts, 3.37 w.-p. c.

Selected at random from a lot of 16-cp, 110-volt, 3.5-watt lamps, tested at rated voltage:

17.25-cp.	71.8 watts.
17.25 "	62.8 "
15.27 "	67.7 "
17.00 "	68.2 "
17.00 "	67.1 "
17.5 "	73.7 "

Average, 16.88-cp. 70 watts. 4.1 w. p. c.

The conditions shown by the above tests are not frequently met with now, another method having been adopted to secure the same

results, as shown in a test lot selected at random from a lot of 16-cp, 111-volt, 3.1-watt lamps:

14.6-cp.	49.0 watts.
12.5 "	49.5 "
14.5 "	49.0 "
14.65 "	49.8 "

Average, 14.06-cp; 49.33 watts; 3.5 w. p. c.

From a lot of 16-cp, 105-volt, 3.5-watt lamps:

11.25-cp.	58 watts.
11.00 "	50 "
10.25 "	54 "

Average, 10.8-cp; 55.3 watts; 5.1 w. p. c.

It will be noted that the total watts consumed by these lamps would not be excessive were they of full candle power, but it is excessive for the amount of light actually delivered. A watt-meter would not detect this fault in the third and fourth lots, but would in the first and second.

It is not meant to convey the impression that all lamp makers impose upon their customers in this manner, yet it is done more frequently than is generally believed. The only sure check is for every company to equip itself with a first class lamp testing outfit. It is not expensive and is really a necessity.

A standard portable voltmeter and an ammeter or wattmeter should be possessed by every electrical station. The photometer can be had at an exceedingly low price, so cheap, in fact, that no company can afford to be without one. The immediate result of persistently photometering all lamps is shown in a test selected at random from a lot of 16-cp, 110-volt, 3.1-watt lamps:

15.75-cp.	49 watts.
16.4 "	48 "
16.5 "	48 "
16.25 "	49 "
16.75 "	50 "

Average, 16.33-cp; 49.8 watts; 3.05 w. p. c.

From the statement made with reference to the initial efficiency of lamps it might appear that no advance has been made in the art of lamp making, but in fact there have been great improvements. The lamp of to-day has a better candle-power curve and is more uniform and when operated under similar conditions will give much better service than its predecessor.

It is unreasonable to expect the best results from lamps operated on a fluctuating voltage, particularly if the fluctuations carry the voltage above normal. They will doubtless stand 2 or 3 per cent increase, but the result will be shorter life and fewer candle hours. The following table shows the effect of increased voltage upon the candle-power total watts, watts per candle and life of the 3.5 watt lamp:

% voltage.	C. P.	Watts.	W. P. C.	% life.
100	16.	56.	3.5	100.
101	17.	57.2	3.37	81.5
102	17.9	58.4	3.26	67.8
103	19.	59.6	3.14	65.6
104	19.9	60.9	3.06	48.2
105	21.	62.2	2.96	40.2
106	21.8	63.5	2.9	30.

As to the loss of candle-power of lamps burnt above normal, the contrast between a new lamp and one that has burnt a few hundred hours is very slight when operated at normal, but becomes more marked as the voltage increases. Increasing the voltage to give a good light itself defeats the end most desired. Though the lamp will burn brighter at first, after a short while the candle-power curve shows a marked decline and soon falls below that of a normally operated lamp, so that during the latter part of the life it is really dimmer.

It is also erroneous to assume that a lamp burnt on a fluctuating voltage will give the best results, even though the average of the voltage is the same as the normal voltage of the lamp. As is well known, all lamps gradually lose their brilliancy almost from the moment they are put into service. A lamp's value is determined by its watts per candle-power and candle-hour area, or, in other words, by the amount of light derived from the current consumed.

The current consumed by a lamp during its life is worth ten-fold more than the lamp itself. It is estimated that the cost of free renewals will not exceed 15 per cent of the total expenses, so we may assume the 85 per cent representing fuel, labor and maintenance is the cost of the electric current, all of which is consumed in the lamps for the production of light. Is it not of importance, then, to know what is received for the greater part of the expense account? For this the use of a photometer is essential and should be a part of the regular work of every station. Unfortunately is it not, and inconsistent as it may seem, there are those who doubt the reliability of the photometer, while insisting strenuously that they want correctly rated lamps.

It is argued that the personal equation enters into the work with a photometer to such an extent as to render it almost impossible for two workers to agree, and that under the very best of conditions only approximate results can be obtained, consequently there is little satisfaction in working under the conditions ordinarily prevailing in a central station. Further, that as a number of factories furnish satisfactory lamps without being checked up, they will continue taking their chances, particularly as their employes are usually busy on other work which appears to yield a better and more immediate return.

Admitting that absolutely exact work cannot be done, we know that the photometer is exceedingly reliable and by using an incandescent lamp for a working standard and exercising proper care the percentage of error will be negligible, especially where comparative tests only are made.

That it is impossible to secure ideal conditions for testing lamps in the ordinary central station is also admitted. If the refinements of a lamp are to be brought out it is better to have the work done in a laboratory equipped for the purpose, but ordinarily it is more important to learn what results are being secured under the prevailing conditions. This will show what the customers are actually getting.

If the test shows the lamps to be unsatisfactory the trouble may be looked for in the voltage regulation, in the lamps or in both. In testing not only should different makes and types be tested, but also lamps of different voltages and efficiencies. It is frequently more desirable to make the lamp fit the voltage than to change existing voltage conditions. Particularly is this so if the voltage has been carried above normal, because, were it reduced the old lamps on the circuit would burn so dim as to make it necessary to replace them. Therefore it is better to determine just what lamps are best suited for the service and adopt them. By exercising great care in making these tests it will be possible in many instances to find 3.1 watt lamps so satisfactory that their use would be warranted.

The useful life of a lamp is determined by the number of hours it burns before losing 20 per cent of its rated initial candle-power. A simple method for determining the candle-hour area is to multiply the average candle-power by the number of hours in its useful life.

Until quite recently the highest efficiency offered in 220-volt lamps was 4 watts per candle-power, but now an exceedingly satisfactory 3.7-watt lamp is offered and recommended for general use. The filament of this lamp is unanchored. The useful life is about 650 hours and the area about 10,000 candle hours.

There is not nearly as much trouble in systematic lamp testing as is generally supposed. For a medium or small station an average of thirty minutes per day or three hours per week will usually suffice. If ten per cent of the lamps received are measured initially, a criterion of the entire lot is secured. If they are accepted, one lamp from each barrel should be placed in life test and another, as nearly as possible the same initially, preserved against the accidental breakage of the test lamp, when the test may be started again with this second lamp. The readings may be taken after every hundred hours burning, the candle-power curved plotted and the area calculated.

A suitable test rack may be placed at some convenient point where it is possible to keep an accurate account of the hours of burning. As the object is to learn the area or candle-power hours delivered to the customers it is neither necessary nor desirable to make an effort to deliver a more uniform voltage to the test lamps than to those in regular service.

This will place the lamp maker in a position to compete on the basis of the merit of his lamps and an incentive is offered for greater effort on his part to improve the quality thereof. There is no reason why lamps should not be brought on the basis of their true worth rather than as simply so many glass bulbs, brass bases and filaments.

A series of tests made by a large central station on five makes of lamps is presented to illustrate the value of making tests as above outlined. Each lot consisted of ten lamps. Lot 1 gave the best results and was used as a standard for comparison. The lamps tested were 111-volt, 3.1-watt. The comparative value of the lamps is as follows:

Lot 1—Average area, 8200.0 candle hours, or 100.0 %.
Lot 2—Average area, 4032.0 candle hours, or 49.2 %.
Lot 3—Average area, 3927.9 candle hours, or 47.9 %.
Lot 4—Average area, 2522.2 candle hours, or 30.8 %.
Lot 5—Average area, 615.7 candle hours, or 7.5 %.

The comparative value of the lamps is proportional to their candle-power area. The accompanying illustration gives the curves of one test, in which the candle-power area of Lot 2 is 62.9 percent of Lot 1.

Taking Lot 1 as the standard for comparison, Lot 2 having an area of 49.2 per cent as much, the lamps are worth just 49.2 per cent of those in Lot 1. On this same basis the value of each of the other competing lots may be determined.

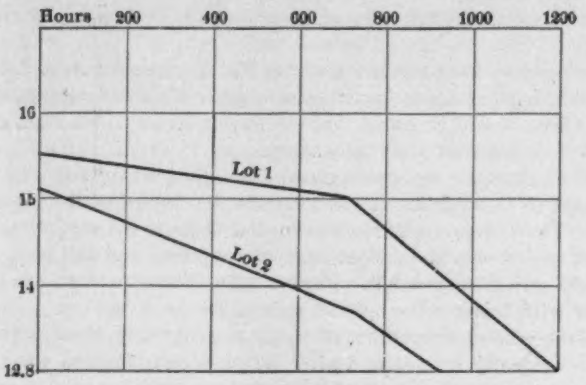


FIG. 5.—CURVES OF LAMP TEST.

With this in view it would appear that the photometer is really quite valuable when properly used and the benefits to be derived therefrom are greater than can be derived from any other source for the same outlay.

The Industrial and Electrical Situation in Germany.

BY DR. LIONEL FLEISCHMANN.

UNDOUBTEDLY many people in this country have been surprised to hear of the unsatisfactory financial conditions now prevailing in the German electrical industries as emphasized by the collapse of the Kummer concern in Dresden. Still, to the unbiased onlooker who was cognizant of the state of affairs prevailing in the United States after 1893 this has not come unawares.

If we want to grasp the existing situation fully we must go back to the nineties. Up to that time the German industries had made slow but steady gains, owing to conservative management and careful and painstaking work. The wealth of the country was accumulating, interest on money declined, and Herr von Miquel, then Minister of Finance of Prussia, created the new type of 3½ per cent and 3 per cent German Government loan. This conversion took place during the same years when all financial conditions in the United States were unsettled, causing many German holders of American securities, afraid of free silver, to sell out. Both these events created a plethora of money which was looking for paying investments. The numerous industrial banks were quick in grasping the situation. Electric power transmission over long distances had been proven a possibility during the International Electrical Exhibition in Frankfort, and the lay world was only too willing to believe that this new force would in a very short time revolutionize all then existing modes of travel and lighting.

A number of smaller electrical concerns doing a limited business were then in the field. The banks bought them up and floated the shares, the first issues of which were sold at a moderate premium. All larger German towns were then contemplating the erection of lighting and power plants. Each concern tried to secure as many orders as possible, and nothing was done to distribute this demand over a larger number of years. The then only medium-sized shops had to be enlarged rapidly, demanding new capital which the public was only too willing to subscribe at a high premium, as actually big orders were in hand. This was the first period.

Of course the number of towns being limited outright orders did not continue coming in as fast as in the beginning. The shops, once erected, had to be kept busy, and the electrical concerns, like the man who buys horses and a truck in order to cart the feed for these very same horses, began founding subsidiary companies. With what result we shall see. Contrary to the practice in this country, public franchises are not given away as a present in Germany. Then the subsidiary companies stepped in as bidders, and there being as many of these companies as factories, a scramble began and prices for franchises went up. In some cases the municipality had the plant built by an electrical concern, leased it to the subsidiary company, which not only guaranteed a fixed interest on the invested amount, but also promised to divide the net earnings, giving the greater amount to the municipality. Besides, horse car lines were bought up and converted into electric lines. These for some time proved to be the most profitable undertaking. But this, too, came to an end. Then the subsidiary companies turned their activity towards foreign countries. Buying up water-power plants wherever they were to be found came to be the fashion. At one time, calcium carbide factories were the fad, in consequence of which the price of this article is to-day so low that a good many of those factories work at a loss. The financial relations between each minor company and its factory were such that each held a large amount of the other's shares, and as the German laws prescribe that in the balance sheet valuation of stocks the latter have to be either carried at cost or at their market value, the lower always having to be taken, a sort of pyramiding in decline or rise was the consequence.

This gives the clue to the present situation. There is no doubt in my mind that the remedy for all these troubles will be the one which has worked such wonders within the last five years in the United States, namely, consolidation.

Conversion from Alternating-Constant Potential to Constant-Alternating Current.*

In a paper with the above title, read at the recent convention at Ottawa of the Canadian Electrical Association, Professor R. B. Owens, after referring to the several methods of street-arc lighting, considered in detail the constant-current transformer system, and in particular pointed out the advantages of a method of obtaining constant current from constant potential by means of a combination of impedance coils and condensers.

The special merits of the first-mentioned system are stated to lie in its high efficiency and close regulation, and the small space required as compared with motor generator sets, and the insulation of the arc circuits from the generator. The power factor is, however, poor, about 80 per cent under favorable conditions at 60 cycles, and 70 per cent at 125 cycles, and decreases rapidly with the load.

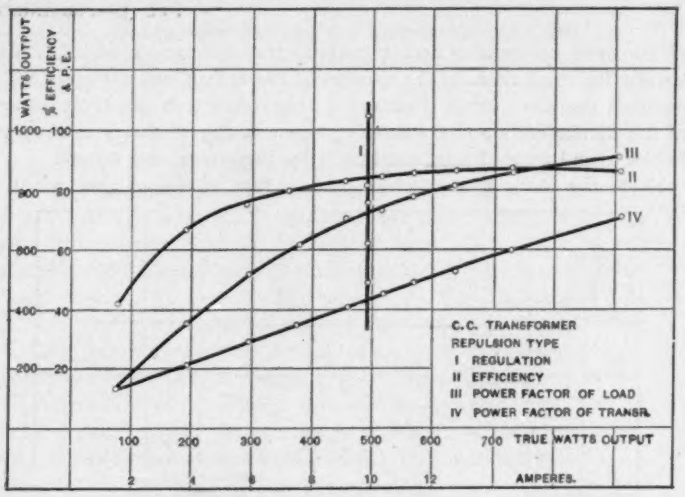


FIG. 1.—TESTING SMALL CONSTANT-CURRENT TRANSFORMER.

Fig. 1 gives the results of tests of a small constant-current transformer—1 kilowatt, 1000 volts, 1 ampere—of the repulsion coil type. The performance of so small a unit is not as good as can be obtained in larger sizes, but, as all sizes possess certain characteristics in common, the results shown will serve purposes of comparison.

Curve 1 is the regulation curve, and shows that with proper adjustment the regulation may be perfect. Curve 2 is the efficiency curve, and shows that while the maximum efficiency is not high in

*Abstract of paper read at the Ottawa Convention of the Canadian Electrical Association.

this particular size, nevertheless a good efficiency is maintained throughout a considerable range. Curve 3 is the power factor of load, and curve 4 is the power factor of the transformer and load. It will be noted that the power factor of the combination is uniformly lower than the load power factor, which is characteristic of all sizes within the limits of commercial practice.

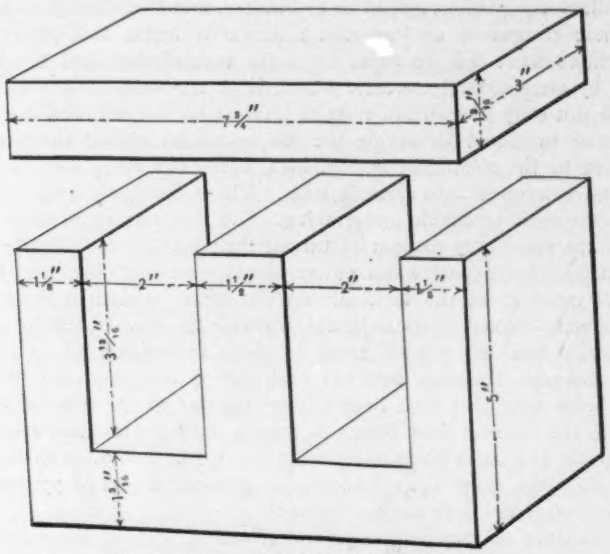


FIG. 2.—FORM AND DIMENSIONS OF CORE.

The particular object of the paper is to emphasize another method of constant potential-constant current transformation which, while known for some time, in the opinion of the author has not apparently received the attention it deserves. This consists in the combination of impedence coils and condenser shown in Fig. 2, due originally to Leblanc, and treated mathematically by Steinmetz and others.

From the theoretical consideration it can be shown that when a constant potential is applied to two equal magnetic reactances with a variable non-inductive receiver circuit, the receiver circuit and one reactance being shunted by a condenser whose capacity reactance equals either magnetic reactance, the current in the receiver circuits will remain constant and be independent of the receiver circuit resistance.

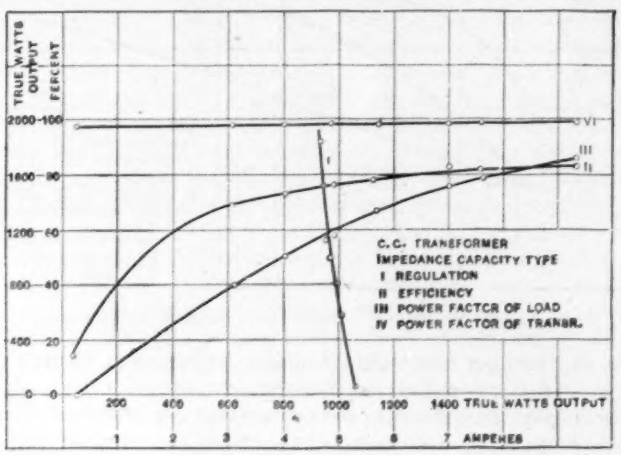


FIG. 4.—RESULTS OF TEST.

To test such an arrangement practically two impedance coils were constructed, their reactances being made variable by the insertion of strips of rubber under their keepers, and connected in series with a smaller coil of constant reactance and a variable non-inductive receiver circuit. The form and dimensions of the core are given in Fig. 2. The coil consisted of 490 turns of No. 12 B. & S. wire, having a resistance of .98 ohm. The laminations of the core were of 16 mil iron.

Fig. 3 shows the arrangement of the apparatus. A 28 microfarad condenser shunted the receiver circuits and the two impedence coils. The reactance of the two coils in the receiver circuit was made as nearly as possible equal to the reactance of the remaining impedance coil and also of the condenser. Five hundred volts at 55 cycles were then applied to the main circuit, and the efficiency and the power factor of the combination noted, as well as the current in the receiver circuit.

The results of the test are given in Fig. 4. As the power factor of the receiving circuits is varied from a small value to something over 80 per cent, it will be noted that the power factor of the main circuit remains throughout practically unity.

The efficiency is nearly constant through a wide range, although not high in this particular case, due to the design of the impedence coils. The regulation curve shows that the current in the receiving circuit varied only some 6 per cent between half and full load, a sufficiently satisfactory result. Perfect regulation, however, can be obtained with better proportioned apparatus.

On the whole, the results, though not as good in some particulars as can evidently be obtained after a full development of the system, are nevertheless of considerable interest to central station managers, as they clearly point to a method of constant potential-constant-current transformation possessing the characteristics of high efficiency, unity power factor, close regulation, absence of moving parts and requiring a comparatively small floor space. In conclusion, Professor Owens expressed the hope that some of our larger makers will devote further attention to the method.

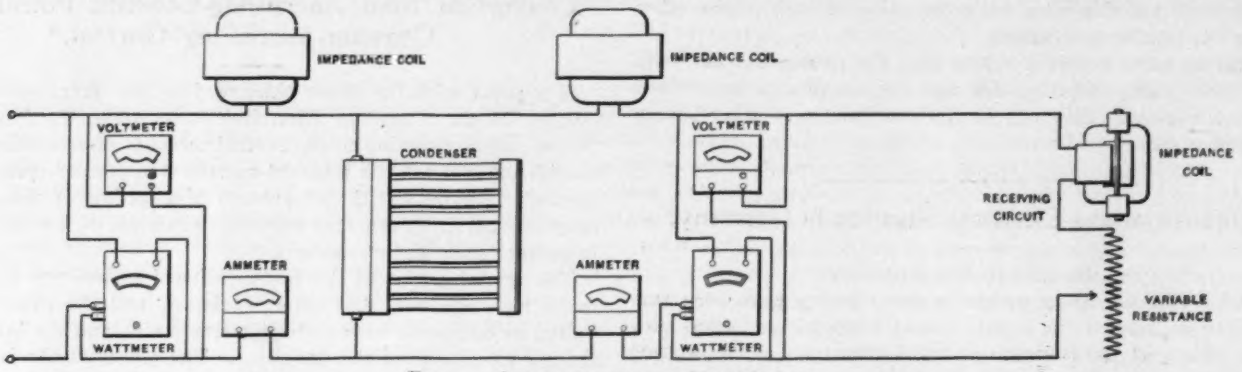


FIG. 3.—ARRANGEMENT OF APPARATUS.

The Telephone in Railroad Service.

In a paper with this title read by Mr. F. P. Valentine before the recent Buffalo meeting of the Association of Railway Telegraph Superintendents some very interesting facts were given, which show the remarkable growth in the use of the telephone in the operation of railroads. It is estimated that to-day, in the United States, there are some 200 private branch exchanges operated by the various railroad companies, connecting over 5000 stations. The growth which has taken place in the last three or four years has been such as to indicate unlimited possibilities in the way of development within the next few years.

Mr. Valentine then noted a few of the many uses to which the telephone is now applied in railroad work. Among these are calls for reservations, information as to time of arrival and departure of trains, and a multitude of other questions. It was stated that the ticket office of the Fall River line in New York is one of the busiest in the country from a telephone point of view. As an illustration of what the public has to suffer from insufficient telephone facilities, it is interesting to note that even with a branch exchange having five trunk lines to the public, with a telephone in the ticket office, with one man giving his entire time to the reservation of staterooms and with the switchboard operators relieving him of many calls by giving general information when reservations were not needed, the lines were still reported busy 1600 times in one day. As may be

imagined, such a condition of affairs brought serious criticism from the public, and it was necessary in this case in order to relieve the congestion on the wires, to double the number of trunk lines, holding them exclusively for incoming business while other lines were installed for the outgoing traffic. A small turret switchboard was installed in the ticket office, having several lines to the main branch exchange switchboard. This enabled the clerk in the ticket office to handle several lines at once, and in an emergency two clerks could be taking the calls and giving out the reservations. When the number of calls for the ticket office was greater than could be handled on the lines between the switchboards, the operators were instructed to take the numbers of the subscribers and call them up in rotation as they were able to handle them. The conditions in this case were almost the reverse of the usual use of a branch exchange for, ordinarily, calls coming in over the trunk lines are switched to many different points, while here the bulk of the business was for one office. Like conditions, undoubtedly, prevail at many points, perhaps to a less extent.

He next pointed out the utility of the telephone in freight offices, where calls for rates and information as to shipment or delivery can be quickly furnished. At one of the largest freight yards in the country there is a completely equipped branch exchange in which three clerks are employed to furnish such information. Many receivers of freight are notified by telephone at once of the arrival of goods, thus securing prompt removal of the freight and relieving congestion in the freight houses. Where there is much competition for business between different roads, it is often necessary for a traveling agent to get into immediate touch with his superior. If he can step to the nearest pay station and call up the local switchboard of his company and through them be connected with headquarters of his company, in two or three minutes the matter may be settled, perhaps resulting in the securing of business that otherwise would go to a competitor.

Insufficient telephone equipment, resulting in the constant inability of prospective shippers to get into communication with railroad offices will often lose a large amount of business when an immediate decision must be made, and it is found that the offices of a competing road are, through adequate telephone facilities, easily reached. A certain telephone company, noticing such a situation, took pains to have the lines of two competing railroads monitored and the result showed that the road whose telephone was constantly reported "busy" lost enough business to its competitor in one day to pay the rental of a complete branch exchange equipment for a year.

Mr. Valentine then instanced the use of the telephone at a large terminal where every tower and switch cabin is connected to a switchboard in the passenger station, thus keeping dispatchers, yardmasters, towermen and switchmen in close touch with one another. All concerned being kept posted as to the situation within the yards it was now possible to extend and continue to a safe time limit the switching movements involving the main line tracks, whereas, before this use of the telephone, delays to trains on the main line were inevitable. Other resulting economies were effected, one being the saving of two switch engines.

One of the largest passenger terminals in the country has a very complete telephone service, the main exchange being located in the office building. Every official has direct connection from his desk to the exchange. The general yardmaster, the trainmasters, towers and cabins are all connected to the switchboard, besides having direct lines to the points with which they have most business. The main interlocking tower, which controls all the yard movements incidental to handling 775 odd trains pr day, has a special switchboard, to which are connected the outlying towers, switch cabins, yardmasters, signal bridges, etc., with trunk lines to the main exchange. Incoming trains are reported to the operator by telephone, and he is constantly in touch with every movement being made. Not a telegraph instrument is in use at any of the yard points, the telephone being the only means of communication. The yardmaster also has a small switchboard, giving him direct connection with the various points he has to reach. In case of a bad fog, when the signals cannot be readily seen, men are stationed at the signal bridges on which are placed telephones in boxes connecting with the switchboard in the interlocking tower, and the trains are handled without delay and with safety. There is hardly a place in the immense plant where any man is stationed, having special duties, that he cannot be reached at once by telephone. All wires are underground—not an overhead wire in the yard—and there has yet to be an instance of any failure in the service night or day.

In installing telephone systems a great mistake is often made by railroad companies, Mr. Valentine said, in endeavoring to economize in the number of instruments. Enough should be provided to care for every branch of the service under any conditions that may arise. This is especially true in relation to offices handling train service. The branch exchange should not only afford connection with points in the immediate vicinity of the terminal, but it will be found advantageous to extend the lines to the outlying towers and stations, supplementing the telegraph service, and in many cases economizing in the number of telegraph operators it is necessary to employ, as there are many stations and towers where it is unnecessary to issue train orders and the use of the telephone relieves the telegraph wires of miscellaneous business which often delays more important matters. If the extension of these lines from the switchboard is carried out so that a pair of wires is run along the main line through the more important divisions, such wires also become valuable in emergencies. If a wrecking car is equipped with a compact telephone set, as soon as the car arrives at the scene of the wreck, instant communication may be established with the dispatchers and division headquarters by means of these division lines. Several instances have occurred recently demonstrating the value of this emergency service, where a telephone was attached to a telegraph pole within a few feet of the wreck, connected with the wires running to the switchboard at division headquarters, allowing the division superintendent, who was on the ground before the wrecking car arrived, to keep in touch with the dispatcher and the towers on each side of the wreck, and, as soon as one track was clear, permitting the movement of a number of delayed passenger trains with little loss of time. In this case no telegraph was available, but it was the opinion of the superintendent that, had it been, the work could not have been accomplished with equal satisfaction or expedition.

He pointed out the advantage of connecting the various block signal stations by telephone as well as by telegraph. In some instances block stations on entire divisions have been equipped by telephone on lines running to switchboards at division headquarters to the exclusion of telegraph, and all business with and between the towers is transacted by telephone. He next referred to the advantageous use of the telephone in connection with the train ferry service in New York Harbor, where the railroads are required to float their cars from the docks of one road to those of another. By the use of the telephone dispatching system an appreciable increase has been made in the number of cars handled daily, and an economy in tug movements.

While it is universally admitted that the use of the telephone under the branch exchange system at terminals is essential, it is only recently that progress has been made in connecting the various terminals by long distance lines. This has opened up a new field, and the results obtained by connecting the various switchboards in different cities along the line of the railroads are leading to serious consideration on the part of railroad officials of extensive additions to this service. The fact that a general officer, sitting at his desk, is enabled to communicate almost instantly with his subordinates at all points on the line effects great economy in the transaction of business and excels in value the use of the telegraph or train mail. The fact that principals can deal direct with one another instead of through the medium of a telegraph operator has much to do with this. Five minutes conversation will often accomplish more, with definite results, than half a dozen letters or telegrams, with the delay involved in handling the matter by the latter means. The railroads that have established these long distance lines are finding them increasingly used, from the executive down.

While the expense of installing these lines makes it necessary to economize in their use, it is astonishing how much business may be transacted daily over one pair of wires, if the service is properly handled. From records taken, the average length of time consumed per connection on railroad business for calls between distant points appears to be about three and one-half minutes. This would permit in nine business hours about 150 messages. If such lines extend over a large territory, connecting several switchboards, of course, the different parts of a line may be worked simultaneously without interference. To obtain the best results a careful study of the use made of the lines by the various departments and of the handling the calls must be made. This will show that by properly systematizing the operation it is possible to increase the capacity of the line surprisingly. A long distance line in operation by one of the leading railroad companies of the country, connecting branch ex-

changes in four cities on its main line, thus breaking the line into three sections, is handling some 250 calls per day very comfortably, and it is estimated that some 10,000 letters and telegrams per month are saved. This cannot but have its effect on all branches of the railroad service. It is not thought that the maximum capacity of the line has yet been reached. The operators have been carefully trained in the handling of the calls for the various officials, preference being given to those highest in authority.

By discriminating between calls, and by intelligent operation, practically instantaneous service is afforded the executive officers, while other calls of importance are handled next, leaving less important business to fill in the time on the wire. To accomplish such results, a system of tickets carefully checked is necessary. These tickets should show time call was received, forwarded, connected and disconnected, with a code record of all attempts made to complete connection, reasons for delays, etc. The facts thus shown are often of value in case of dispute, and, from these tickets, a chart can be readily made, showing just what the line is doing at any minute during the day. From such a chart defects in operation can be immediately detected and corrected. With the development of this class of service many problems arise which require careful study, as many of the conditions attaching to public service do not apply to the railroad service.

As to the equipment best suited to the needs of the various departments, Mr. Valentine thought the subject worthy of some attention. Originally a desk set was considered somewhat of a luxury, but in the case of an official having to answer from 30 to 40 calls per day, much time is saved by the telephone being right at hand instead of his being obliged to leave his desk for the call. Some rather interesting figures have been taken giving the comparative results of the use of the desk stand as compared with the ordinary wall equipment. In the case of two railroad exchanges connected by a long distance line, one being equipped mostly with wall and the other with desk stand sets, it was found that it took, on an average, 50 seconds longer to get the person ready to talk with wall sets than with the desk stands, which, on the number of long-distance calls per day, amounted to a loss of one out of six busy hours in the use of the circuit. The rental of the line amounted to several dollars per day, while the cost of proper equipment was but a few cents per day.

In closing his paper, Mr. Valentine called attention to several matters of practical importance in developing and equipping a railroad telephone system. He advocated uniformity of equipment, and held that a properly organized force to make repairs, inspections, etc., should be maintained. The residences of operating officials should be equipped with a telephone so that such officials could be quickly reached out of business hours in case of emergency. He pointed out that a great deal of dissatisfaction with telephone service, resulting in claims of liability to error in the transmission of messages by telephone, was due to the fact that only about 10 per cent of the users of telephones know how to talk and use the instrument properly. Telephone patrons should be taught to use the instrument.

It has been found of some advantage to utilize stenographers as switchboard operators, so that messages may be taken in the absence of the person desired, and on his return can be delivered to him. The use of stenographers and typewriters in connection with railroad telephone service will, Mr. Valentine thought, be developed with the extension of the service. It is imperative to use only the best class of equipment to give satisfactory service. Much of the criticism as to the danger of transmitting train orders by telephone has been justly based on the poorly constructed lines and cheap equipment used by many of the railroads under the belief that economy in initial cost is the principal thing to be considered. "It can be predicted," said Mr. Valentine in conclusion, "that the next few years will see some developments in the application of telephony to railroad service that will surprise some of those whose conservatism has led to the long delay in the appreciation of what seems destined to become the chief means of communication of the future."

In the discussion of Mr. Valentine's paper, Mr. Henry W. Pope, of the Buffalo Bell Telephone Company, gave a very interesting account of his company's methods, and how some of the problems mentioned in Mr. Valentine's paper had been solved. Touching the subject of party line service he stated that he did not believe in it, and that all such service, especially on business lines, had been rooted out in Buffalo. He advocated a more liberal use by railroads of trunk lines, and pointed out how easy it was for railroads to lose business by not having adequate telephone facilities. The successful operation of branch exchanges depended much upon the operator. He advised getting operators from the telephone companies for branch exchanges, because they were better trained to the work. He pointed out that many of the alleged troubles with the telephone service were not due as much to the telephone as to the person using it. Not one person in a hundred, he said, knows how to use a telephone properly. The people required to be educated in this respect, and he proposed to make this subject a matter of thorough study when his company got things in shape. In speaking of the wide field of application of the telephone, he referred to the use of telephone street boxes on electrical railways in Buffalo. There were many of these boxes in use. A flash lamp was used at each box, thus enabling headquarters to reach cars out on the line by flashing the lamps. On seeing a lamp flash the conductor or driver is required to dismount from the car and communicate with headquarters from the box for instructions.

The Edison Storage Battery.

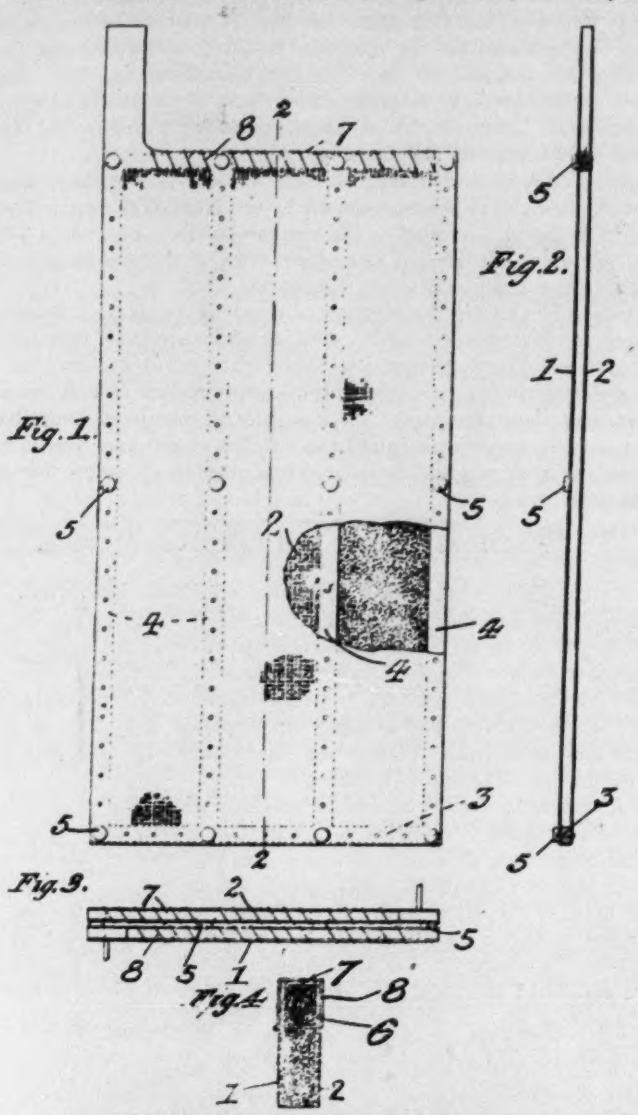
We reproduce below from the June issue of our English contemporary, *The Electro-Chemist and Metallurgist and Metallurgical Review*, what appears to be the full specifications of an English patent recently granted to Edison, and relating to the type of cell which formed the subject of a paper recently read by Mr. A. E. Kennelly before the American Institute of Electrical Engineers.

In the drawings, Fig. 1 is a face view of one of the plates for supporting the elements, having pockets or receptacles, and showing the front wall partly broken away; Fig. 2 is a section on the line 2—2 of Fig. 1; Fig. 3 is a plan showing two of the plates forming a single combination, and Fig. 4 is an enlarged detailed section.

Each plate is formed with two walls 1 and 2 of very thin sheet nickel (say, about .125 mm. in thickness) bent around a horizontal frame 3, from which extends the vertical spacing frames 4, 4, to all of which frames the sheet is secured by nickel rivets to form a strong, rigid, hollow plate with pockets or receptacles between the vertical frames 4, 4. The walls 1 and 2 of the plates are perforated with small holes arranged very close together and about .75 mm. apart. These holes may be punched in the plates as shown, but they are preferably formed by merely stretching the metal without removing it, forming burrs projecting inwardly from each hole, thereby greatly increasing the area for contact between the metal and the active material. Nickel is preferably used in the construction of the plates, as it is not electrically oxidizable in an alkaline solution, but iron may be employed if carefully and perfectly plated with nickel, or the frames 3 and 4, instead of being made of nickel or of nickel-plated iron, may be made of hard rubber or other inert material, to which the perforated sheet is riveted. A number of insulated spacing blocks 5, 5 are secured to the plates to prevent them from touching when immersed.

In the manufacture of the new oxidizable element, monosulphide of iron is first preferably taken and crushed so that the particles will pass through a screen having about 6.4 openings per square millimeter, and about eight parts by weight thereof are mixed with about two parts by weight of flake graphite, the particles of which are somewhat larger than the perforations in the plates. This mixture is moistened with a 20 per cent solution of potassic hydroxide, and the dampened mass is packed into the pockets or receptacles of the proper plates by a suitable tamping tool, after which a wad of asbestos fibre 6, about 6 millimeters in thickness, is introduced into the pocket or receptacle above the mass, being held in position by a strip of sheet nickel 7 secured in place by nickel wires 8. The element thus formed is subjected to electrolytic oxidation in a solution of potassic hydroxide, sulphur being set free and combining with the alkali to form a potassium salt, which diffuses out of the mass, and the iron being converted to an hydroxide thereof. The diffusion of the alkaline sulphur compound is facilitated by alternately reversing the oxidizing current to subject the contents of the plate to successive oxidation and reduction until the whole of the sulphur is eliminated. The element will then be ready for use when the iron has been reduced to the metallic state. Since iron does not decompose water, there is no local action between it and the graph-

ite. The iron oxide formed as explained increases the bulk, and, being mixed with graphite, produces considerable pressure on the walls of the plate, thereby preventing any disturbance of the initial state of the mass, even when internal gas is strongly generated by overcharging. The object in using the monosulphide is to secure the greatest amount of iron oxide in the smallest space and in the peculiar form capable of being reduced to the metallic state electrolytically. Dried oxides of iron are not reducible to any extent by the current; spongy iron reduced by hydrogen from different iron salts is oxidizable only to a slight extent by the current; iron hydrates are very bulky and difficult of use without drying, which operation effects some obscure change therein to render them nearly inert in the presence of a reducing current; and bulky ferric hydroxide is capable only of slight reduction. In fact, the only oxide of iron capable of reduction appears to be that produced as explained or when monohydrate is produced by boiling ordinary ferric hydrate



FIGS. 1, 2, 3 AND 4.—EDISON STORAGE BATTERY.

for many hours in water; but in the latter case the increased bulk prevents the introduction of as much iron into the pockets as with the hydroxide obtained by the oxidation of the monosulphide. By forming the oxide in the first instance, as explained, from the monosulphide, the oxide is secured in very compact form and capable of being perfectly reducible by the current. Furthermore, finely divided iron obtained as described, when subjected to electrolytic oxidation, does not form a soluble ferrate. The improved oxidizing element is therefore absolutely permanent, so that the electrolyte is not changed at any stage of the working.

As to the improved oxygen storing element, the inventor has discovered that the lower oxides of nickel and cobalt, when in contact with a conductor in an alkaline solution, can be almost wholly raised to a higher stage of oxidation electrolytically, which higher oxides revert to the lower stage by reduction with extreme ease, and he has therefore constructed an oxygen storing element which is capable of great capacity, of less weight, and of higher permanency than any electrode for the purpose which has heretofore been applied. Neither nickel oxide nor cobalt oxide is appreciably soluble in an alkaline electrolyte. Both give nearly the same voltage in use, but nickel is preferable on account of its cheapness. I therefore preferably first precipitate the hydrated oxide of the metal, say, nickel, which oxide is slowly dried at ordinary temperatures, being then powdered and passed through a screen having about 6.4 meshes per square millimeter. Seven parts by weight of the powdered hydrate are mixed with three parts by weight of flake graphite, and moistened with a small quantity of water, the dampened mass being inserted in the pockets or receptacles of the proper plates in small quantities at a time, and being thoroughly tamped at each accession. Finally the mass is covered with a layer of asbestos held in place by a plate of nickel secured in position by nickel wires, as described in explaining the make-up of the oxidizable element. These plates are then immersed in a solution of potassic hydroxide in water, and subjected for a considerable time to an oxidizing current of about 8 milliamperes per square centimeter of surface, thereby converting the first oxide to a higher oxide, whereupon the element is ready for use. The object of employing graphite is to offer a great extent of surface against which nearly the whole of the oxide is in contact, this being necessary since the electrolytic reduction and oxidation do not extend to a great distance from the conducting surface against which the oxide is in contact, although the higher oxides of nickel and cobalt seem to be conductors. Graphite is neither affected by electrolytic oxidization, nor is there local action between it and the oxides. Nickel hydrates instead of other nickel compounds are preferably used because they are easily prepared, and by absorption of the liquid they swell within the pockets to insure intimate contact and stability, while they are not reduced to the metallic state electrolytically.

The elements are preferably utilized together in a solution of 25 per cent of potassic hydroxide in water. Owing to obscure reactions when the battery is discharged, and to a change of resistance in the electrodes, the voltage of the improved cell is invariable, but averages 1 volt, rising as high as 1.38 volts when freshly charged. The battery can be over-charged, fully discharged, or even reversed and charged in the opposite direction without injury. Over-gassing does not disturb the initial state of the elements. All the ingredients are insoluble. The plates are unattacked by electrolytic oxidation, and the whole operation is independent of the strength of the solution; so that the battery is of great permanence and of remarkably light weight.

A German translation of this patent is also contained in the *Centralblatt fuer Accumulatoren und Elementen-Kunde*, June 15, to which the editor of that journal adds the following critical note:

"The patent in its essential parts combines only known elements. Higher nickel oxydes have been used by Michalowski for the positive plates, and iron was long ago proposed for the negative plates. Only the constructive details and the formation are new."

References are made to patents of Michalowski and of the Accumulatorwerke System Pollak. Michalowski (German patent, April 19, 1899) patents the use of peroxide of nickel Ni_2O_3 as positive plate in an alkaline cell with zinc as negative plate. He forms the nickel plates as follows: He heats a metallic nickel plate in pure oxygen or in gases containing oxygen, to a temperature above 300 degs. C., below the red heat temperature; the oxydizing action is accelerated by applying a high pressure to the gases. Not only the ordinary oxygen, however, but also nascent oxygen causes a good oxydation of nickel at a temperature above 300 degs. As the oxydation does not enter deeply below the surface, the unattacked metal remains as a support of the active mass and guarantees good conductivity and good adhesion. Nascent oxygen is obtained by heating with oxydizing reagents, which give off their oxygen between 300 and 600 degs., such as nitrates, chlorates and others. Ammonium nitrate is especially adapted, because this salt does not leave any residue after the heating. Porous nickel is impregnated with the fused salt and heated cautiously; after this treatment has been repeated several times all pores of the nickel are entirely filled with the solid oxide. It is also possible to oxydize nickel with nascent oxygen by using the nickel as an anode in a fused electrolyte, containing oxygen, between 300 and 600 degs. This also gives a solid and compact cover of oxide.

Accumulator plates of iron, positive as well as negative, which are claimed to be very solid and to have a high capacity, are made

by the Accumulatorenwerke System Pollak, according to a German patent of Aug. 17, 1898. Iron powder or compounds of oxygen with iron are compressed while wet, and are then heated, so that they come into a porous but solid state. The electrodes are then formed electrolytically, in an alkaline solution, for instance, NaOH. The iron powder or the oxygen compounds of iron are generally moistened with nitric acid or another oxidizing agent, and are afterward compressed. The oxydizing agent is then removed by heating to a red heat, or in any other manner. As electrolyte with electrodes of this kind, such solutions can be used which either form insoluble compounds or none at all, with the electrodes as, for instance, alkalines, bichromate of potassium, phosphoric acid, etc.

From these patents it is evident that the "passive state" had not kept inventors from using nickel oxyde and iron plates in batteries, as had been claimed. On the other hand, the cell, described above, of Michalowski, is not of the type of the new Edison battery. Michalowski uses zinc as negative electrode, and zinc dissolves. The Michalowski cell is therefore of the type of the old Edison-Lelande cell. Furthermore, Michalowski speaks of Ni_2O_3 plates, while Dr. Kennelly, in his paper on the new Edison cell, expressly states that the charged nickel plate in the Edison cell is nickel hyperoxide NiO_2, a higher oxide than the peroxide.

Interuban Trolleys in Indiana.

There are now 200 miles of interurban electric road out of Indianapolis, connecting with the principal cities of the Indiana gas belt, and there are in round numbers 1000 miles projected at present for Indiana. The interurban roads afford an hour schedule for passengers, and less frequent freight hauls into the city, and are heavily patronized by the farmers along the line and the residents of the towns and cities which they connect. That they are successful in their efforts to get business is evidenced in the efforts of the railroads, whose tracks are now paralleled by the electric lines. Where there are parallel lines the railway companies have cut the local rates and have put a better train service into operation. Some observers believe that the solution of the difficulty can only be by the death or absorption of the interurban lines, or the abandonment by the railways of their local business. At present there seems to be hardly enough business for both. There are those who hold that the railroads will absorb the electric lines, but there is no tendency observable in the present situation that will justify such a contention. Both sides are preparing to fight, and of the contest, in its initial stages, no accurate forecast of the outcome can be made.

A likely development is a combination of the major part of the interurban lines in the hands of a single syndicate. The Elkins-Widener people have lately acquired the Union Traction Company's lines, which are the most extensive in the central part of the State. They also control the Indianapolis Street Railway Company and the Cincinnati street lines. Out of Cincinnati they control a line going north into Indiana. Lately they are reported to have acquired the Indianapolis and Greenfield line. There is at present a line projected from Greenfield to Dayton, Ohio, which will complete the chain from Indianapolis to Dayton, and lines which will ultimately connect Chicago and Cincinnati by way of Indianapolis are talked of. It is believed that before many years the Union Traction Company will absorb most of these traction companies, and that there will be a unified system connecting Indiana, Ohio, and Illinois.

The last Indiana Legislature made it possible for this outburst of traction building to occur by giving the traction companies the same right of eminent domain, allowing them to condemn land, as the railroads. In this way companies which have been unable to get rights of way over the highways are now getting private rights of way. The road between Indianapolis and Logansport, which has been retarded for two years for this reason, is one that shows the utility of the last Legislature. The Indianapolis *News* publishes a map showing the present and projected trolley lines in the vicinity of that city. They are so numerous as to present the appearance of a spider's web, with Indianapolis as the central point. The *News* says: "That the railroads feel that they are to be confronted by a powerful rival is apparent from the effort the Big Four, the I. & V., and the J. & M. & I. companies are already making to meet competition. It is believed by many that the railroads will eventually be forced into buying up the electric lines in order to save themselves, as it is not thought they can continue the competition for long when the odds in operating expenses are so heavily against them. It is even now rumored that some of the steam roads are interested in the franchises that are being obtained for electric lines that will parallel them."

Data on New York Conduit System.

Justice Earl, of the Court of Appeals, sitting as a referee, gave a hearing last week in the fight that is being made by many large corporations in this city against the constitutionality of the Franchise Tax law. The case of the Consolidated Telegraph & Electrical Subway Company, of New York, was heard. William J. Sefton, secretary and treasurer, testified that the original capital of the concern was $3,000,000, of which amount $732,000 has been expended for patents and property acquired by the proceeds of the sale of stock, the market value of which, at the present time, he declared, is only $3 per share. There are outstanding $4,225,000 in bonds, $1,875,000 in stock and $545,405 in unpaid coupons of the company, which owns 142 miles of subway, of which only part is earning a profit. The State Board of Tax Commissioners has assessed the company's property at $5,000,000, but the company appealed to the Supreme Court, asking that the amount be reduced to $1,000,000, and has declared itself in default on its bonded indebtedness to the extent of $784,000 in interest. Last year the company's operating expenses, Mr. Sefton said, fell $12,000 short of the earnings.

Since 1898, he said, there has been only one sale of the company's bonds, which were then purchased by the New York Gas & Electric Light & Power Company. The company's stock, he said, is held at the par value of $100. The balance sheet of the company, he said, would show a deficit of about $48,000 for 1900.

Edwin R. Quinby, the engineer of construction of the subway company, testified to the cheaper methods of construction that are possible to-day, chiefly through the substitution of vitrified clay for iron in the manufacture of ducts. While the original cost of construction was about $2,000,000, the company having been compelled by the city to lay many conduits from which it received no income whatever, the system could be reproduced now, he believed, for about $890,000.

Wisconsin Independent Telephone Meeting.

At La Crosse, Wis., last week the Wisconsin independent telephone companies had a meeting, there being delegates present from 26 companies in the State. The meeting was held in the city council chamber, when Mayor Boschert welcomed President Hutchinson and his associates, and the president made an interesting address. Mr. R. S. Abbott read a paper on telephone conditions in Michigan and Wisconsin. During the afternoon a visit was paid to the new La Crosse telephone exchange.

At the second day's session a hot discussion relative to the relations with the Bell company occurred. The matter came up on a motion to exclude all members who are in any way affiliated with the Bell people. The discussion showed a unanimity of determination to fight to the bitter end. A resolution was passed that all companies having any business relations with the Bell company be disciplined. A resolution was also passed that a committee of grievances be appointed to thoroughly investigate all cases where independent companies are, or are suspected of affiliating with the Wisconsin (Bell) Telephone Company.

A resolution to establish uniform toll charges all over the State was passed unanimously. A committee was appointed to take charge of the matter, and it is thought probable that a big reduction of toll rates will be made in the committee's report.

Mr. Burch, of Madison, read an interesting paper on the maintainance of the best telephone service and many important ideas were brought before the convention in this way. The convention adjourned at noon, to meet again next February in Milwaukee. They expressed themselves as highly pleased with the reception and entertainment they had received in this city.

Tunnel Under the Narrows.

Tunneling the Narrows of New York Harbor for an electric road is now proposed. The New Jersey & Staten Island Junction Railroad Company, which was first proposed by Erastus Wiman, and which increased its capital stock to $10,000,000 last January, has begun active work. The purpose of the company is to run a double steel tube tunnel under the Narrows, build 12 miles of railroad on Staten Island, and connect with several trunk lines in New Jersey across the Kill Von Kull bridge. The estimated cost of the tunnel is $3,500,000.

LIBRARY OF THE UNIVERSITY OF CALIFORNIA

CURRENT NEWS AND NOTES.

REMITTED TAXES.—This week the war taxes of 1 cent on all telegraph messages and 1 cent on all 15-cent telephone messages goes off. So ends a great nuisance for which there was little offset in the shape of revenue.

ELECTRICAL CONTRACTORS.—The national meeting of the Electrical Contractors' Association will be held at Buffalo, on July 17. Mr. W. H. Morton, 31 Catharine Street, Utica, is secretary. Information also can be obtained as to rooms, etc., from Mr. H. I. Sackett, president of the Buffalo Contractors' Association, Builders' Exchange, that city.

ELECTRIC EXPRESS SERVICE IN NEW YORK.—Four express cars were started over the surface lines of this city on June 27 as the first step in the system recently projected by the Metropolitan Street Railroad Company. Preparations are already under way to establish terminals in White Plains, New Rochelle, Yonkers and all the towns in the southern part of Westchester County. The old mail cars formerly used on the old Third Avenue Line are being pressed into service. The formal opening took place on Monday last, when 10 cars were put into service.

POLYPHASE ARC LAMP.—A patent granted June 25 to the Edwin W. Rice, Jr., describes an arc lamp for use with polyphase currents. As illustrated applied to a two-phase system, there are two lower stationary carbons connected to two of the leads of a two-phase circuit, and a larger upper movable carbon connected to the third lead. For use on a four-wire, two-phase system, the movable carbon may have a common connection with two of the leads. With this arrangement some one of the phases is always active in maintaining the arc, and a steady light is produced at a much lower frequency than is possible with a single-phase current.

ELECTROLYTIC GLOW LAMP.—A patent issued June 25 to Isidor Kitsee relates to means for starting up electrolytic lamps when introduced into circuit. When a pencil of this kind of lamp is moistened with a solution containing a slight percentage of metallic salt it becomes a partial conductor, and the method invented consists in spraying the pencil with a liquid consisting of a solution of two per cent of magnesium or one per cent of acid. When the switch connecting the pencil to the circuit is closed the pencil is sprayed with the liquid by means of a bulb attached to the lamp. The passage of the current will then raise the temperature of the pencil to such a high degree that the moisture will evaporate and leave the pencil with a temperature sufficiently high for the passage of current even after the moisture has entirely disappeared.

NATIONAL STANDARDIZING BUREAU.—The act of Congress establishing the National Standardizing Bureau provided for a visiting committee of five members, to consist of men prominent in the various interests involved, and not in the employ of the Government. In conformity with this requirement the Secretary of the Treasury has named the following committee: Professor Elihu Thomson, Professor E. L. Nichols, Professor Ira Remsen, Dr. Henry S. Pritchett, president Massachusetts Institute of Technology, and Henry Ladd Colby, secretary American Association of Steel Manufacturers. The duty of the committee will be to visit the Bureau at least once a year and report to the Secretary of the Treasury on the efficiency of its scientific work and the condition of its equipment. We understand that Professor E. B. Rosa has accepted the position of physicist to the Bureau.

CARBIDE FURNACE WITH SERIES ARCS.—A patent recently issued (June 25) to Dr. Hugo Koller, of Nuremberg, Bavaria, describes a carbide furnace adapted particularly for use with currents of higher voltage than are usually employed for work of this character. It is provided with two carbon terminals or end electrodes, entering a long narrow furnace structure from opposite ends, and a number of intermediate unconnected carbon blocks, functioning as bi-polar electrodes, and serving to produce several arcs, or at least several zones of high temperature, in series. The conception of series arcs for industrial purposes is not new, having been applied by Hunter to an arc lamp of double power, by Girard and Street to furnaces for the graphitization of carbon, and by Hopkins to a laboratory furnace for the study of high temperature reactions. Indeed, it is probable that many of the carbide furnaces in which a body of the product lies between the terminals operate in this manner, and one at least, that of Cowles, is so described; the precise form taken by the current in the interior of the furnace charge is, however, not easily determined. The simplicity of Koller's construction suggests especial practicability for large units. The hearth may be of any desired length, the terminal electrodes being simply heavy carbon blocks built into the end walls. The intermediate carbons are supported above the furnace bottom, in the plane of the terminals, and in number depending upon the available voltages, the usual charge of coke and lime being heaped around and above them. The effect is to sub-divide the furnace into a series of zones of reduction corresponding to the intervals between the blocks. It is in these reaction zones that the formation of carbide occurs, and to prevent its contact with the hearth additional blocks of carbon, either in the form of heavy plates or of shallow crucibles, are placed beneath the adjacent ends of the raised electrodes and directly upon the bottom of the furnace. These blocks may also serve to some extent to conduct the current, and by virtue of their position below the regions of maximum temperature they act as receptacles or supports for the carbide formed.

ELECTROLYTIC TREATMENT OF COPPER ORES.—Some years ago Dr. Karl Hoepfner proposed a process for the treatment of copper ores, consisting substantially in laminating them with a solution of cupric chloride containing sodium chloride, and subjecting the resultant cuprous chloride solution to fractional electrolysis to precipitate one-half of the copper at the cathode while simultaneously regenerating the solution by reoxidation to the cupric state, at the anode; the regenerated solvent was then to be returned to the ores and the process repeated. In practice the method has scarcely fulfilled expectations by reason of the very low reaction velocity between the sulphide and chloride of copper. While there is no doubt that cupric chloride will react as stated, the time element must be considered, and this is found to be much greater than is the case with the ferric salts employed in an analogous manner in the well-known process of Siemens and Halske. The U. S. patents of June 25 contain one to John C. Kessler, of Milwaukee, Wis., which bears a close resemblance to the Hoepfner method. Kessler's process is intended for the treatment of ores containing native copper, and his solvent, like Hoepfner's, is a cupric compound, but in ammoniacal solution. A solution of hydrated oxide of copper in ammonia, or any of the cuprammonium salts, as the carbonate, sulphate or chloride, may be used, and in practice this solvent is admitted to the tanks in quantity sufficient to cover the ore, the evaporation of ammonia being checked by a surface stratum of water. As in the prior process the solution becomes reduced by taking up the metal to the lower state of oxidation, and electrolysis is invoked to regenerate it with recovery of one-half of its copper. It is stated that 24 to 48 hours suffices to entirely exhaust the ore of its copper, that other metals present are unattacked, and that the action is accelerated by the addition of ammonium salts to the solution. It is not stated, however, with what strength of solution or with what grade of ore these results were obtained, nor is the proportion between solvent and ore given. The difficulty of handling solutions containing much free ammonia is well known, and it will be necessary to show high efficiency and rapid action to establish a commercial value for the new method.

LETTERS TO THE EDITORS.

Combination Dynamo Fields.

To the Editors of Electrical World and Engineer:

Sirs.—In the case of combination field frames of either cast and wrought iron ,or cast iron and steel, all the authorities and writers appear to have clearly established the great importance of increasing the contact surfaces between the two materials joined. This letter would be unduly lengthened were it to mntion the many references I have at hand corrborating this statement. Limiting myself to one authority, I quote as follows from the very useful treatise by Mr. A. E. Wiener on "Dynamo Electric Machines":

"If wrought iron and cast iron are butt-joined, the capacity of the joint is reduced to that of the cast iron, whereby the advantage of

the high permeability of the wrought iron is destroyed and the permeance of the circuit is considerably increased; in order to have the full benefit of the wrought iron, the contact area of the joint must be increased proportionally to the ratio of the permeability of the wrought iron to that of the cast iron at the particular density employed."

The practice, however, of the leading manufacturers of dynamos in America and Europe, with very few exceptions, is simply to butt-join the cast iron with the wrought iron or cast steel parts. Is the disaccord between the books and actual practice due to the fact that in the mechanical construction of the frame the former introduces cylindrical or conical fits, while the latter involves only easily produced plane surfaces? Would not this difference be more than compensated for by gain in economy in exciting power due to the higher permeability of the magnet frame?

LIMA, PERU. A. GRIEVE.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Weight Economy of Electromagnetic Machines.—SEEFEHLNER.—A paper, read before the Electrotechnical Society of Vienna, in which he draws from a large number of statistical data of actual machines, conclusions concerning the weight of a machine per unit of power, as a function of the power. The results of his statistical compilations are given in diagrams. He first gives a diagram of transformer weights, from data of transformers made by fifteen different manufacturers; then also diagrams of induction motor weights, three-phase generators, and direct-current motors; finally he gives a diagram showing the average weights for these different machines. Among other things the diagram shows the following facts. A difference in the weights of single phase and three-phase transformers is not to be recognized in the diagrams; in general the single phase transformers are even lighter than the three-phase transformers, while according to the theory the latter should be lighter by 30 per cent. All the curves show the same character; up to a certain size the weight of material per unit of power decreases very rapidly with increasing capacity, while for higher capacities the weight per unit of power is nearly constant and changes only very slightly with increasing capacity. Of all the machines considered, the transformer shows in general the best weight economy. From the diagram of the average curves the following data are taken: For a capacity of 5-kw the weight in kilogram per unit of power is 43 for the induction motor, 47 for the transformer, 70 for the direct-current motor; at a capacity of 10-kw the weight per unit of power is 36 for the transformer, 37 for the induction motor, 55 for the direct-current motor, 75 for the three-phase generator; at a capacity of 20-kw the weight is 30 for the transformer, 33 for the induction motor, 52 for the direct-current motor, 58 for the three-phase generator; at a capacity of 100-kw the weight is 28 for the transformer, 31 for the induction motor, 40 for the direct-current motor, and 42 for the three-phase generator.—*Zeit. f. Elek.*, May 12, 19.

REFERENCES.

Speed and Size of Three-Phase Generators.—SIEWERT.—A mathematical article on the influence of the surface speed upon the dimensions and the active weight of material of three-phase generators. He discusses the question, what dimensions and weight will an economically designed three-phase generator have, if for constant speed and frequency the surface speed is increased?—*Elek. Zeit.*, June 6.

Winding Magnet Coils.—An illustrated description of a winding machine for magnet coils, and of a counter provided to count the number of turns of the coils.—*Am. Mach.*, June 20.

Shunt Regulating Resistances.—HAHN.—A brief article in which he shows how to calculate shunt regulating resistances for dynamos; he also gives a numerical example.—*Elek. Anz.*, June 6.

LIGHTS AND LIGHTING.

REFERENCE.

Regina Arc Lamp.—A diagram showing the results of photometric tests, made by Wedding, of the Regina arc lamp which was noticed in the Digest June 1.—*Elek. Anz.*, May 26.

TRACTION.

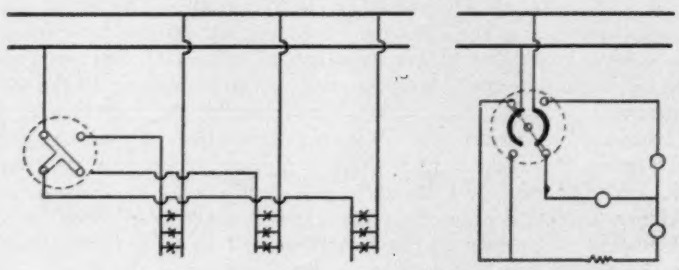
Polyphase Plant.—EBORALL.—The conclusion of his article on polyphase generating and substation plant. He reaches the following general conclusions relative to substation work in general, it being assumed that it is necessary to convert the polyphase current into direct current by means of converting substations. First, for tramway and railway work, and for those cases in which the amount of lighting to be done is relatively small, rotary converter substations, operated at 25 cycles, will give the best results, whatever the type of engine. Second, for lighting work, the use of motor-generators operated at 40 to 50 cycles in the substations, will give the best results; this is also the case when the lighting load in the substations forms the greater proportion of the total output of the latter. "Of course, for industrial power work of large magnitude, or for such power work combined with lighting, spread over a large area, it is hardly conceivable that any experienced engineer would lay down nowadays any system but a polyphase system throughout, preferably three-phase."—Lond. *Elec. Rev.*, June 14.

REFERENCE.

Switzerland.—EDSTROM.—A review of the construction and operation of electric tramways in Switzerland.—*Traction and Transmission*, June 2.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Switches for Lighting Installations.—HERZOG.—An article with 17 diagrams showing different switches for making various special connections in lighting installations. The following cases are dealt with: of several groups of lamps only one group or two groups shall be lighted at the same time; the switching in and out may be accomplished continually by a small electromotor such as is used for advertising signs; connections for dimming the light of electric lamps by switching in resistances or by connecting in series two lamps which are regularly connected in parallel; various connections for arc lamps. Of the two diagrams reproduced, one shows a switch, by which for three positions of the switch, one of three groups of lamps



FIGS. 1 AND 2.—SWITCHES FOR LIGHTING INSTALLATIONS.

is disconnected, while the other two are lighted; for the fourth position of the switch all three groups are disconnected; in the position shown in the diagram the group of lamps at the left is disconnected. The second diagram shows a switch, by which two of three arc lamps are connected in series, while the third is disconnected; this may often be used in practice.—*Elek. Anz.*, May 23.

Best System for Small Plants.—A discussion of the question whether the two-wire, 220-volt, direct-current system or the three-wire, 2x110-volt, direct-current system is to be preferred for a small plant. It is said that one or two years ago the question would have been answered in Germany in favor of the two-wire 220-volt system on account of the following advantages: a cheaper network, cheaper and simpler connections, easier operation. It is said that in the meanwhile the following disadvantages have been brought out in

practice: It was expected that the same line insulation, switches, fuses, etc., could be used for the 220-volt installations as for 110 volts, but this has not been found to be the case. It was furthermore expected that a more economical 220-volt incandescent lamp would be made when the demand for it would grow; this expectation has not been fulfilled; while a 16-cp, 110-volt lamp consumes 3 to 3.5-watt per candle, the average commercial 220-volt, 16-cp lamp consumes 4 watts per candle. These circumstances have increased the cost of installation and operation of the 220-volt, two-wire system beyond the expectations. The conclusion is drawn that the three-wire 2x110-volt system must be preferred at present.—*Elek. Anz.*, June 2.

REFERENCE.

Storage Batteries in Power Stations, Controlled by Reversible Boosters.—HIGHFIELD.—An illustrated reprint in full of his recent papers, an abstract of which was noticed in the Digest, June 15.—Lond. *Elec. Rev.*, June 14; an illustrated reprint in full begins also in Lond. *Elec.*, June 14.

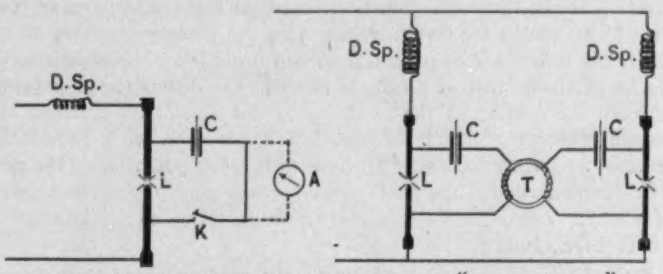
WIRES, WIRING AND CONDUITS.

Protection Obtained by Earthing.—UPPENBORN.—An illustrated paper read before the Union of Electric Works at Wuerzburg. He describes experiments which he made, and which relate to the case of a point of a high tension line touching an iron pole when there is an earth at another point of the line. The questions were, whether it is dangerous to touch that iron pole, and what success may be obtained in general by a good earthing. The arrangement of his experiments was as follows: One pole of a dynamo was connected to an earth plate, placed in a creek, the other to an iron mast, which was sunk into the ground for a depth of one meter; this iron mast was also connected to an earth plate, placed in a river. The current and the e. m. f. between the iron mast and the earth at various distances from the mast were measured. The results are given in a diagram. He found that at a supply e. m. f. of 2000 volts, the e. m. f. between the iron mast and the earth at a distance of half a meter, was 580 volts, so that touching the mast would be very dangerous. He concludes that the earthing of the pole is good only when the resistance of this earth is much smaller than the resistance of the other earth. With ordinary earth plates the resistance can scarcely be made smaller than 20 ohms. Iron masts are a source of danger and should be covered as well as possible; to earth them is not advisable. He has made some special experiments with iron poles as used for trolley lines; he advises not to earth these iron poles. There was a long discussion following the paper. Wilkens suggested placing in the earth at the foot of the iron pole a concentric metallic plate, the size of this plate depending upon the conductivity of the earth; he claims that this would prevent potential differences between the feet, and also between the feet and the hands. Uppenborn will make experiments with this device.—From a separate publication of the Union of Electric Works at Wuerzburg; reprinted also in *Elek. Zeit.*, April 25.

Bloemendal.—A communication referring to Uppenborn's paper. He mentions a case from practice, in which an imperfect earthing was found to be dangerous. In the same way as Wilkens, he uses in high tension installations, a metallic passage around the generators and switchboards, which is connected to parts carrying no current. —*Elek. Zeit.*, May 30.

ELECTRO-PHYSICS AND MAGNETISM.

New Actions of the Direct-Current Arc.—PEUKERT.—An illustrated description of experiments to which he has been led by the demonstration of the "musical arc" by Simon and Duddell. He has succeeded in producing acoustic actions with the arc without the use of a microphone or telephone, merely by producing the current variations in the arc itself. The arrangement is shown in the first of the adjoining figures. The carbons of the arc were shunted by a condenser *C* of 7.7 microfarad, consisting of a paper condenser of 6.4 microfarad, combined with a rubber condenser of 1.3 microfarad. When the key *K* is pressed down and the arc *L* has a certain length, about 0.75 mm, the arc gives a high sharp tone which continues as long as the condenser circuit is closed. The length of the arc may be varied in small limits, the pitch of the tone is then also changed. As soon as the arc length is above a certain limit, the tone stops, but starts again when the arc is brought back to its original length. The induction coil *D Sp* in the figure keeps the oscillations off from the main circuit. This is a very simple arrangement for producing alternating currents of high frequency and low voltage; in two experiments made by him the frequency was 8800 and 9200, the voltage 40 and 43. By this device all the well known experiments for demonstrating the characteristic features of alternating currents can be made, especially the experiments of Elihu Thomson. The tone from an arc can easily be transferred to a second arc by means of the ar-



FIGS. 1 AND 2.—DEMONSTRATION OF THE "MUSICAL ARC."

rangement shown in the second figure. *T* is a simple ring-transformer. The two lamps burn in parallel. When the two arcs have a certain length and the condenser circuit of the first lamp is closed this lamp begins to give off a tone and the other then follows.—*Elek. Zeit.*, June 6.

Properties of the Ether.—GRAETZ.—An exposition of a theory of the properties of the ether which he has developed in order to clear up the obscurities attached to Maxwell's electromagnetic theory. He claims that his theory is free from contradictions, either in itself or with experiments. He assumes the ether to be an elastic solid, and therefore attributes to it the same properties as Fresnel and Neumann did. In ponderable matter the ether experiences an influence which is manifested as force as soon as there is a displacement in the ether. The force exerted by the molecule upon the ether is manifested in a local change of the density of the ether, while the ether retaliates by displacing the molecule from its normal position. Those parts of a material body in which such a displacement exists permanently, are the ions. This action and reaction between the ether and the molecules leads to Maxwell's equations. The so-called magnetic polarizations, or displacements, are determined by the torsion of the ether elements, while the electric forces, all except some characteristic ones, are the velocities of the ether particles. The magnetic energy of a body is the potential energy of the ether contained in it. The electric energy consists of two parts, one of which is the kinetic energy of the ether, while the other is the potential energy of ponderable matter. "True magnetism" assumed to be zero in Maxwell's theory, has no meaning whatever. The magnetic properties of iron may be brought in as special molecular torsion. The so-called "true electricity" consists of the amount of ether contained by a given volume in excess or defect of the normal amount. A current consists of the transformation of rectilinear motions of molecules into heat vibrations. The conceptions that the ether surrounding every molecule is attached to it implies that a totally independent relative motion of ether and matter, is impossible.—*Ann. der Physik.* No. 6; abstracted in Lond. *Elec.*, June 14.

Velocity of Different Ions.—CHILD.—In previous researches he found that when a discharge passes between a flame and a neighboring metallic plate, the quantity discharged varies nearly in proportion to the square of the difference of potential and inversely as the cube of the distance. He found that the velocity of the negative ions exceeded that of the positive ions by 25 per cent in the average, which result was in striking contrast to the measurements made with the electric arc, where the positive ions exceed the negative ions in velocity by 100 per cent. Zeleny's method of measuring the velocity of X-ray ions was applied by him to the arc, and the positive ions again showed double the velocity of the negative ones. The author has since investigated an arc between mercury electrodes in mercury vapor, where no second substance intervenes. The greatest potential gradient was then at the anode, so that the positive ions move fastest. The author makes the interesting proposition that whenever gases are ionized, the negative ions move most rapidly, but whenever metallic vapors are ionized, the positive ions move most rapidly.—*Phys. Zeit.*, May 18; abstracted in Lond. *Elec.*, June 7.

Electric Oscillation Experiment.—PELLAT.—A description of the following experiment which appears somewhat paradoxical at first, but which is easily explained by electric oscillations. Two condensers of very unequal capacities, say, a battery of six large jars and a small Leyden jar, are connected by means of a commutator mounted on ebonite columns, so as to be able to deal with high potentials. All the armatures, or at least three of them, are insulated.

Two discharging rods are attached to the small condenser, and they show a spark when the difference of potential reaches a sufficiently high value. If now the condensers are charged so as to give sparks, or even a little less, and the connections are reversed, the spark passes between the rods. Since the reversal makes the positive coating of one condenser communicate with the negative coating of another, the difference of potential should diminish. Nevertheless, the discharge shows that at a certain moment the difference of potential between the coating of the small condenser must have doubled at a certain moment. This is of practical importance, as it shows that reversal of connections may produce dangerous potentials. He gives a full explanation of the phenomenon, based upon the current theory of electric oscillations.—*Comptes Rendus*, May 13; abstracted in Lond. *Elec.*, June 7.

Dark Cathode Space.—WEHNELT.—An account of an investigation of the distribution of potentials in discharge tubes. The equipotential surfaces are concave with respect to both anode and cathode. The curve of potential is continuous in every case, and sharp bends, as found by Graham, must be attributed to faults in the method.—*Phys. Zeit.*, June 1; abstracted in Lond. *Elec.*, June 14.

Discharge by Flame Gases.—VON WESENDONCK.—In an investigation of the destruction of gaseous conductivity by smoking liquids, he found that the conductivity of flame gases depended largely upon the state of the surface of the metallic electrodes to be discharged. He has since accumulated further evidence of the importance of the electrode surface. An account of his observations is given. He suggests that flame gases may have a peculiar radiation of their own which produces the change of surface conditions.—*Phys. Zeit.*, June 1; abstracted in Lond. *Elec.*, June 14.

Nickel at High Temperatures.—CAMPBELL.—The conductivity of pure, modern, nickel is very much lower than that of the purest obtainable some years past. He tested two specimens, both commercial products, one bought this year, the other five or six years ago. Their resistivities at 0 deg. C. were found to be 8 and 12 microhm-cms respectively. He investigated their behavior at different temperatures up to 700 deg., the results being given in a diagram. Both temperature and resistance curves have the well-known bend at about 300 deg. C. The older and presumably less pure specimen has less variation with temperature than the other, of which the mean temperature coefficient is slightly over 0.5 per cent per degree from 0 to 200 deg. —Lond. *Elec. Rev.*, June 14.

Permeability of Nickel Steels.—PAILLOT.—An account of measurements of the permeability of nickel steels in intense magnetic fields. The first series of measurements was made with samples of "irreversible steel" containing 24.1 per cent of nickel and 0.3 per cent of carbon. It was shown that there is a distinct increase of permeability in raising the field intensity from 20,000 to 30,000 units. On the other hand, two samples of "reversible steel" containing some 27 per cent of nickel, retained a constant permeability while the field varied from 4000 to 30,000 units. This is quite in accordance with Guillaume's predictions. When the steel, besides the addition of nickel, also contained small quantities of chromium or manganese, the permeability showed a decided diminution with increasing field intensity.—*Comptes Rendus*, May 13; abstracted in Lond. *Elec.*, June 7.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytically Made Emery Wheels.—RIEDER.—An interesting illustrated article on emery wheels, disks, slabs, etc., made electrolytically in the following way: The grinding kernels of emery or carborundum are fixed on to metallic surfaces by the electrolytic deposition of metals, especially of copper. The simplest case is that of a plane surface to be covered on one side with emery; a layer of emery kernels which have been made conducting by means of graphite, is placed on the cathode which is at the bottom of the electrolytic bath, and the electrolysis is started. The mixing with graphite is done as follows: wax or paraffine is dissolved in benzine and the emery sand is moistened with this solution; after having been dried, each corn is covered with a fine layer of the dissolved material and then mixes easily with the graphite if shaken with it. One may also put the graphitized emery into a porous cup, and this into the electrolytic bath, so that the anode is outside of the porous cup; when the metallic body to be covered with emery is put into the emery sand in the porous cup as cathode, the kernels are fixed on the surface; the layer of copper is then increased in a free bath. Another method is to first mix the emery intimately with a paste "soluble in the bath"; he generally uses gelatine for this purpose; when the deposition has progressed so far that the kernels adhere without paste, all traces of paste are destroyed by dipping into hot lye, and the deposition is then continued. Finally the emery is laid open by grinding; one may also bare the kernels still more by etching. Such electrolytic emery wheels and slabs differ greatly from others. Each kernel is enclosed or "set." To this fact is due the small wearing away of the grinding surface. Of a grinding disk 140 mm diameter, 10 grams of the grinding surface were lost when 70 gram steel were ground, while with other grinding disks at the same number of revolutions and the same loss of grinding material, only 20 grams of steel were ground. The relation can be improved still more by using higher speeds; he then estimates "a maximum loss of 10 per cent for steel." On the other hand more time is required with an electrolytic wheel to grind a certain amount of material; but the number of revolutions may be made several times that of the ordinary wheels. One will also prefer the much harder carborundum to emery, as the higher price is insignificant on account of the small loss of grinding material. He does not intend at present to use this electrolytic method for large rough grinding wheels, but rather for the smaller grinding instruments to be used in workshops. Several forms are described and illustrated; among these are a plane grinding disk for polishing and smoothing off metallic surfaces, small grinding wheels for making holes; a conical grinding shaft for making conical holes, riflers for engravers, etc.—*Elek. Anz.*, June 2.

REFERENCES.

Alkylammonium-Amalgam. — CROTOGINO. — A German Electro-Chemical Society paper, of a more chemical interest, on the electrolytic production of alkylammonium-amalgam.—*Zeit. f. Elektrochemie*, May 23.

Production of Lithium.—An illustrated description of the Becker process of the electrolytic production of lithium from a mixture of chloride of lithium and alcaline chlorides (with the exception of magnesium chloride).—*L'Ind. Elec. Chem.*, March.

The E. M. F. of Metals in Cyanide Solutions.—CHRISTY.—The first part of a long article. In this part he gives a review of the modern theory of electrolysis of aqueous solutions.—*Elektrochem. Zeit.*, June.

Bleaching by Electricity.—WALSH.—A brief description of the processes of Hermite, Brochoki and Leclanche.—*Elec. Rev.*, June 15.

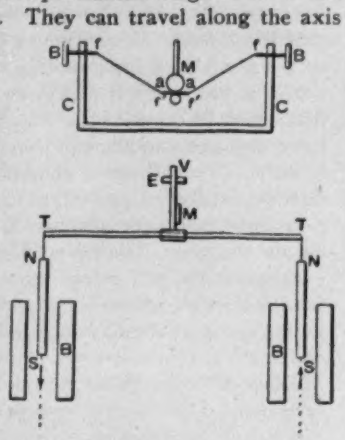
German Electro-Chemical Society.—An account of the eighth annual meeting held in April in Freiburg. Ostwald suggested changing the name of the society into the German Bunsen Society. Van't Hoff was re-elected president. Abstracts of all of the papers have or will be abstracted in the Digest.—*Zeit. f. Elektrochemie*, May 16, 23, 30.

UNITS, MEASUREMENTS AND INSTRUMENTS.

A Perfectly Astatic Galvanometer.—LIPPMANN.—A description of a galvanometer which is quite independent of the magnetic field of the earth. The principle is as follows: A magnetic needle is suspended by a cocoon fibre and allowed to settle in the magnetic meridian. The poles project into coils whose axis is oriented in the same way, and which are traversed by the current to be measured. Hence the needle is displaced in the direction of its own length, and as the earth's magnetic field does not tend to displace a needle in the direction of its own length, that field is without influence upon the displacement, and is as good as non-existent. The needle is, therefore, perfectly astatic. Its suspension is attached to one arm of a torsion balance, which gives the resistance to the displacement. That resistance can be made as small as desired, and the sensitiveness of the apparatus can be thus increased indefinitely. In a galvanometer devised by Becquerel the needle is attached to the arm of an ordinary balance, and sucked into a coil in the same manner. But it is obvious that the substitution of a torsion balance for an ordinary balance greatly increases the sensitiveness. He obtained the best effects by using a thick and heavy needle strongly magnetized. —*Comptes Rendus*, May 13; abstracted in Lond. *Elec.*, June 7.

Electric Balance.—CREMIEU.—Lippmann's perfectly astatic galvanometer (described in the above abstract) has led the present author to construct a balance on a similar principle, which may be used as a galvanometer, an electrodynamometer or an absolute electrometer. It is shown in the adjoining diagram. Between the two branches of a brass frame *CC*, is suspended an aluminum plate *aa*, by a cocoon thread *ff'*. An aluminum tube *T V T*, bearing a movable nut *E*, is attached to the aluminum plate so that it is normal to the plane of the

cocoon threads. The whole represents a balance without knife edge. The moving parts are very light, weighing only 0.8 grammes. The nut *E* serves to regulate the sensitiveness, and the mirror *M* to indicate the deflections. Two cylindrical permanent magnets *N S* are suspended at *T T* by cocoon fibres. They can travel along the axis of the coils *B B*. With a period of 8 seconds, the balance indicates a displacement of 12 mm. at 1 meter distance for a current of 10^9 ampere. The balance is well damped and perfectly astatic. On replacthe magnets by coils carrying currents an electrodynamometer is obtained. An electrometer may be made by mounting a plate and guard ring on one arm.—*Comptes Rendus*, May 28; abstracted in Lond. *Elec.*, June 14.



ELECTRIC BALANCE.

German Reichsanstalt.—The first part of an abstract of the official report of the work of the German Reichsanstalt in 1900. The cadmium standard cell which had been severely criticized by Cohen, was intimately investigated and its practicability for use as a standard cell was proved. There are, however, irregularities in the behavior of the cells containing 14.3 per cent of amalgam in the neighborhood of 0 deg. More dilute solutions, containing 12 to 13 per cent of amalgam must be used; such cells show no irregularities. A detailed account is given of an exact determination of the capacity of a condenser. The conductivity of the chlorides and nitrates of the ordinary alcaline metals had been determined, and that of the iodates has now been measured. Up to one-tenth normal solution the specific conductivity can be represented by an empirical formula, so that the variation of the calculated value from the measured value is not more than one-thousandth of the value. This formula is valuable, as with its aid the conductivity of very dilute solutions may be calculated from measurements of more concentrated solutions.—*Elek. Zeit.*, June 6.

REFERENCES.

Industrial Magnetic Measurements.—MONTPELLIER AND ALIAMET.—The continuation and conclusion of their long illustrated serial. They deal with industrial hysteresis meters. After general remarks about the methods of plotting a hysteresis loop, they describe the hysteresis meters of Ewing and Blondel.—*L'Elec.*, May 18, 25, June 1.

Localization of Breaks.—RYMER-JONES.—The conclusion describing a method for the localization of high resistance breaks in submarine cables. He gives a numerical example and makes some general remarks on the test and on the galvanometer used.—Lond. *Elec. Rev.*, June 14.—Some remarks, by Kempe, on this article in Lond. *Elec. Rev.*, June 14.

Measurements in a Cable Factory.—KREJSA.—A long and well illustrated paper, read before the Electrotechnical Society of Vienna, on instruments and apparatus used for electric tests and measurements in a cable factory.—*Zeit. f. Elek.*, May 12, 19, 26.

Meters.—ARMAGNAT.—Illustrated descriptions, taken from British patent specifications, of a number of new meters, devised by Peloux, Hookham, Price, Schmidlin, Beaumont and Nunns.—*L'Eclairage Elec.*, May 18.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Photographone.—RUHMER.—A description of improvements of his instrument, with which he has achieved some very notable successes. The vibrating flame of an arc lamp is photographed on a kinematograph film, and the sound vibrations are thus translated into dark and bright stripes on the film. The light is concentrated upon the sensitive film by means of a cylindrical lens. When the impression of the voice has thus been taken, the film is developed and fixed in the usual way. To reproduce the sound the film is moved past an ordinary projection lamp, and a sensitive selenium cell provided with telephones and a dry battery is placed behind it. The changes in the illumination of the selenium cell produce changes in the current corresponding to the original sound vibrations. The velocity of the film is 2 to 3 metres per second, but even with 20 c. m. per second good photophonograms are obtained. From one negative any number of positive films may be obtained, and either the negatives cr positives may be used for reproduction. He hopes to record pictures and sounds on the same film. An interesting development proposed is the synthesis of human speech from its elements, obtained from the photophonograms or from an artificial film suitably shaded.—*Phys. Zeit.*, May 25; abstracted in Lond. *Elec.*, June 14.

Some editorial notes in which this instrument is compared with Koenig's manometric analyses and Bell's phonautograph; the former made a record that was both transient and inaccurately shaped, while Bell's instrument, although making a fairly accurate trace of the sound waves on smoked glass, was incapable of being used for reproduction of the actual sound. From a purely graphical point of view Bell's phonautograph was superior to Ruhmer's photographophone, the former showing the complex sound-waves in Cartesian curves, the latter indicating them merely by the irregularity of tint or shade in a photographic strip. Bell's instrument, however, suffers from defects due to inertia, while the use by Ruhmer of the practically inertialess machinery of a ray of light, effectively eliminates that source of error. Ruhmer's instrument should be very useful for acoustical researches.—Lond. *Elec.*, June 14.

High Speed Telegraphy.—An editorial review of recent systems of high speed telegraphy. A comparison of six systems is given regarding the numbers of attendants required and the numbers of words which can be transmitted per minute. With the Morse system, two attendants transmit 15 words per minute, with the Hughes simplex system four attendants 25 words, with the Hughes duplex system six attendants 50 words, with the Baudot quadruple system 8 attendants 120 words; with the Baudot sixfold system 12 attendants 180 words; with the Rowland eightfold system 12 attendants 320 words. These systems are also compared under consideration of the question whether they enable one to send messages over the line in opposite directions. The Baudot system is much in use in France, and is also used in Vienna, London and Berlin, for telegraphy with Paris. With the Rowland system, experiments are being made at present. It is said that there is no great need for the new systems in Germany, as the telegraph service has not increased excessively, and that it is doubtful whether these systems will be introduced there, as the companies owning the patents generally demand exorbitant prices.—*Elek. Zeit.*, June 6.

REFERENCES.

Protection of Telegraph Lines.—The first part of a reprint of a set of rules, issued by the Austrian Ministry for Commerce. General technical regulations are given regarding the protection of telegraph, telephone and signal lines, against installations with strong currents.—*Zeit. f. Elek.*, May 26, June 2.

Block Signals.—PRASCH.—An illustrated paper, read before the Electro-technical Society of Vienna, on the most recent forms of the block signal system of F. Krizik in Prague.—*Zeit. f. Elek.*, May 26, June 2.

Rowland Telegraph.—ROBICHON.—A continuation of his long illustrated description of the Rowland multiple telegraph system.—*L'Elec.*, May 18.

MISCELLANEOUS.

Copper in 1900.—An abstract of the annual statistical circular on copper, issued by Merton & Company. In spite of high prices only 14,000 tons more copper were produced in 1900 than in the previous year, the exact figures being 486,084 and 472,244 tons respectively; the output of the United States was 268,787 tons, against 262,206 in 1899. Figures of the output of different mines in the United States from 1895 to 1900 are given. The production of Canada is slowly but steadily increasing.—Lond. *Elec.*, June 14.

REFERENCES.

Glasgow Exposition.—DARY.—A brief article on the electric generating sets and the lighting of this exposition.—*L'Elec.*, June 1.

Paris Exposition.—REYVAL.—Illustrated descriptions of a 700-kw, 600-volt, direct-current dynamo of Schuckert & Company and of a 400-kw, 500-volt, direct-current dynamo of the Societe Bacini.—*L'Eclairage Elec.*, May 18.—An illustrated description of a 682.5-kw, 250-volt, direct-current dynamo of the Company Generale d'Electricite de Creil.—*L'Eclairage Elec.*, May 25.—An illustrated description of two 415-kw, 250-volt, direct-current dynamos of the Decauville XX Company, driven by one steam engine.—*L'Eclairage Elec.*, June 1.—Illustrated descriptions of three direct-current dynamos of

Alioth & Company, giving 225-kw at 550 volts, 30-kw at 125 volts, and 7-kw at 125 volts respectively; also of a 176.5 kilovolt amp three-phase generator of the same company, the voltage at the terminals being 3000 volts; also of two converters of 300 and 200-kw, of the Societe des Applications Industrielles.—*L'Eclairage Elec.*, June 8.

New Book.

ELEKTRISCHE VERBRAUCHSMESSER DER NEUZEIT. Von Johannes Zacharias. Halle: Verlag von Wilhelm Knapp. 351 pages, 195 illustrations. Price, 15 marks.

As the author states in his introduction, there is, considering the importance of the subject, an amazingly small amount of information available in book form concerning the important field of electric meters. To meet the presumable demand for a work of this kind the present volume was written.

After a gratifying brief introduction and only two pages devoted to the now historical Edison chemical meter, the subject of the modern mechanical types is at once attacked. The Aron differential clock meter is carefully described in over thirty well illustrated pages, in which the theory and mechanical details are alike considered. Then follow the motor meters for direct current of the Thomson and analagous classes, and finally the actual though not avowed main subject matter—motor-meters for alternating current—which presumably receive the principal attention because their theory is less generally understood and because the types on the market in Germany are very numerous, just as is the case in the United States. The manufacturers have co-operated well with the author, so that not only are there many schematic and perspective illustrations, but calibration curves and other actual test data abound. A scheme not generally adopted in this country, but which would seem worthy of imitation in many cases, is the not uncommon continental practice of equipping meters with so-called "testing terminals," by the aid of which a standard meter may at any time be cut in for checking purposes without interrupting the service.

Of two-rate meters, only two are mentioned, one by Aron and the other made by Schuckert & Company, neither of which, however, receives extended attention. Prepayment, maximum demand and true recording meters, i. e., those which record on charts the current variation, are likewise described very briefly and in but few forms.

The last 143 pages are given up to a patent digest which is claimed to include specifications from all of the German patents on the subject. The names of the patentees, titles of patents and in some cases very brief descriptions of the inventions, are given, but there is not a single illustration even of much reduced size; and as the patent drawings are frequently referred to in the specifications, a record which might otherwise be of much interest becomes of but slight value.

The presswork and paper are both good, but the binding is typically German, flimsy and ready to fall apart after but a few days handling.

Some Electrical Features of the Glasgow Exhibition.

As an exemplification of the beauties of electric lighting the Glasgow Exhibition cannot be classed as a success, and very little effort seems to have been made to have produced any illuminating effects. To most of us who have seen the World's Fair Exhibition in Chicago of 1893 or the recent Paris Exposition or the Pan-American Exhibition in Buffalo, and who are accustomed to look for a magnificent illumination in the evening at an exhibition the effect is quite disappointing. The grounds of the Exhibition themselves are lit with gas, producing, it is true, a good illumination, but lacking altogether in artistic effect. There is absolutely no illumination of the buildings and the only effects produced are the various signs on a few of the special pavilions in the Machinery Avenue, such as those on the British Westinghouse Company or the searchlight of the British Scuckert Company. In Machinery Hall the exhibits in general are good and give fair examples of typical British practice in generator and engine designs. Of tramway specialties there is next to nothing outside the manufacture of generators themselves, Dick, Kerr & Company being practically the only exhibitors of a complete line of tramway apparatus, including generators, motors and cars.

The Machinery Hall, already described in these pages, is a large building outside of the real exhibition grounds, reached by means of a covered bridge, and contains some 300 exhibits of various engineering specialties. In one corner of the building are situated the engine and electrical exhibits, most of them comprising engines coupled direct to generators. Throughout the whole grounds, however, are situated other electrical exhibits, and it might be stated that the British Westinghouse Company's exhibit is entirely outside of the Machinery Hall, and in a different part of the grounds. This company has found it necessary to build a pavilion for themselves on Machinery Avenue, while the British Schuckert Electric Company have also got various exhibits distributed throughout the whole exhibition. The Glasgow exhibition might be classed as a purely industrial exhibition, and as such is extremely good, though more attention might well have been paid to artistic illumination and amusements for the visitors. The main building, however, is distinctly handsome, architecturally, and indeed the whole site of the exhibition in the daytime presents a most pleasing effect, all the buildings being clustered in the valley of the Kelvin, overlooked on the one side by the heights on which the university is situated and on the other by the slopes of Kelvin Grove Park, surmounted by Park Terrace, one of Glasgow's most handsome residential thoroughfares. The buildings in general are pleasing to the eye, and a few of them, notably the Russian buildings, with their odd style of architecture, give a most charming vista, situated as they are among the natural beauties of the Park.

WILLIANS & ROBINSON exhibit one of the largest steam electrical plants ever shown in operation by a single firm at an exposition of this kind, with the exception, perhaps, of the Paris Exposition of 1900, where they were also largely represented, and showed a 3000-hp engine coupled to a dynamo. The exhibit at Glasgow is of the same total power as that at Paris, but is divided into two engines, each having a normal output of 1200 horse-power and a maximum of 1500 horse-power. The engines are triple expansion, of the firm's usual vertical central-valve type, and run at a speed of 230 r. p. m. They are supplied with steam at 180 lbs. pressure, and are intended to work with condensation. One engine has a small fly-wheel faced to form a coupling, and the other merely a coupling disk, the necessary fly-wheel power being provided by the revolving part of the dynamo. In both cases the couplings are bolted directly to flanges upon the armature castings, not to couplings upon the shafts. One engine is coupled to a compound-wound, continuous-current dynamo, made by Crompton & Company, having a normal output of 700 kilowatts at 520 volts, and a maximum for one hour of 960 kilowatts at 510 volts. The other drives a dynamo of the same output by the British Schuckert Electrical Company.

E. GREEN & SON, of Manchester, have an interesting exhibit of their well-known economizers in various parts of the Exhibition. In Machinery Hall are one economizer of seventy-two tubes, suitable for one steam boiler, with small engine attached to the gearing frame for driving the scrapers; one 5-inch double ram pump for feeding economizers and steam boilers; one 5-inch horizontal steam engine for driving economizer scrapers, and specimen economizer castings, including tubes burst at a pressure of over 3000 lbs. per square inch. There is also the bronze model of Green's economizer, which gained the highest award for economizers at the Paris Exposition last year. A special pavilion in Machinery Avenue has been built in which is erected a larger size economizer, containing 192 tubes, arranged on the most modern principle, in three groups, couples together at the top and bottom with expansion elbows, and with space at the back affording easy access to all parts of the apparatus. The scraper motion of this economizer is actuated by a 1-hp motor in a glass case. This economizer contains nearly 2000 square feet of heating surface. A 5-inch double-ram pump is coupled up to the machine, showing the method of feeding. One high-pressure economizer of 192 pipes, in sections of eights, arranged in groups, has been loaned to the Exhibition authorities, and is working in connection with four Lancashire boilers, supplying power for driving the machinery plant in the Exhibition. The scrapers of this economizer are worked with a small independent engine attached to the gearing frame. One economizer of 120 pipes, in sections of sizes, arranged in two groups, working with a battery of Davey-Paxman boilers, which are supplying power for the electric light in the Exhibition. Both these economizers are fitted with the usual blow-off and safety valves, and are constructed for boiler pressures of 200 lbs. to the square inch. The scrapers on this economizer are also worked by a small independent 3½-inch cylinder.

THE LAHMEYER ELECTRICAL COMPANY, LIMITED, of London, exhibits a motor generator of 100 horse-power, consisting of one syn-

chronous motor for single-phase alternating current, driving a 65-kw, shunt-wound dynamo, which is running as a motor on account of no alternating current being available. The company also shows one starter for the above, one regulator for the exciting circuit of the synchronous motor, one automatic hoist controller, one 5-horse-power totally enclosed dust and water-tight motor, one three-phase, 3½-[illegible] asynchronous motor, one crane controller, and one double crane controller with universal gear.

THE GENERAL ELECTRIC COMPANY (1900), LIMITED, of London and Manchester, show a fine steam dynamo, comprising a high-speed engine direct coupled to a multipolar dynamo made at the Manchester works. The capacity is 420 amperes at any voltage from 460 volts to 500 volts on lighting load, and 500 volts to 550 volts, 300 amperes, on traction load. These dynamos can be overloaded 20 per cent. on lighting load, and 25 per cent on traction load. The machine is, of course, overcompounded for traction work, the compounding being cut out for lighting service. The magnet frames of the generator

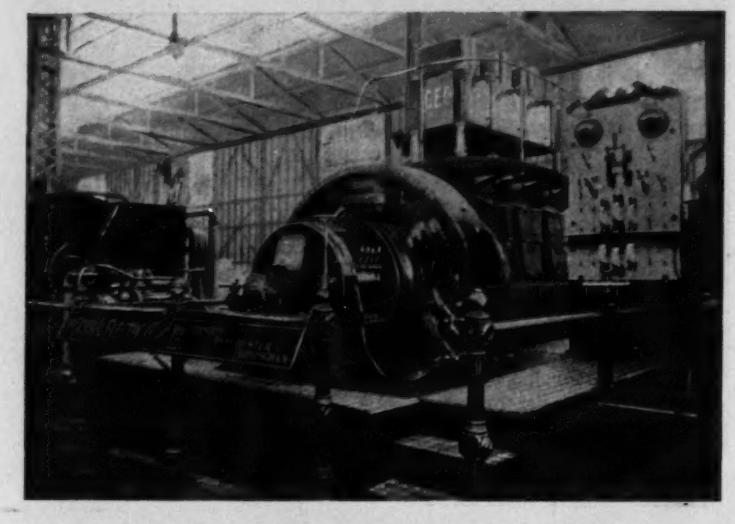


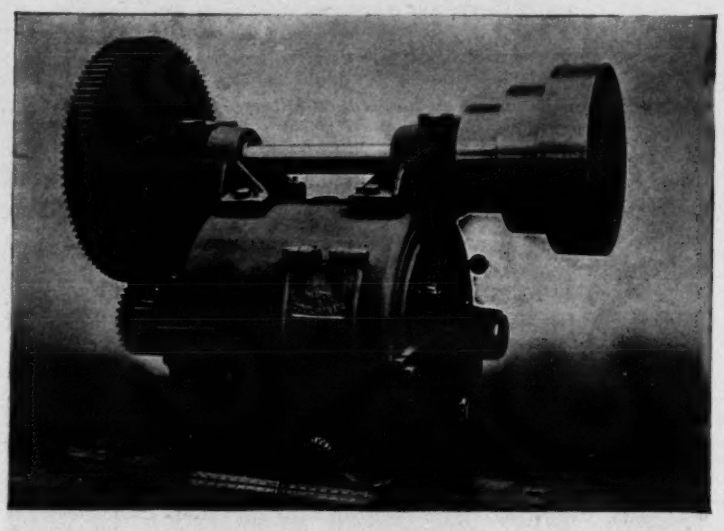
EXHIBIT OF GENERAL ELECTRIC COMPANY, LIMITED.

are divided on the horizontal diameter, and have especially light fields and yokes much resembling the typical American standard. The pole pieces and field coils are of cylindrical shape. The armature is of the fly-wheel type of large diameter, with slotted core. The carbon brushes can be retained in fixed position and run sparklessly from no load to 25 per cent overload. The engine is of the well-known "Peach" type, made by Davey, Paxman & Company, and develops 360 horse-power. It is a three-crank compound engine, with centrifugal governor, and runs at a speed of about 380 r. p. m. The dynamo supplies power to the General Electric Company's motors, which are driving various sweetmeat manufacturing machines and other machinery for various purposes in different parts of the Exhibition. There is also a fine general exhibit of electrical apparatus.

THE BRITISH SCHUCKERT ELECTRIC COMPANY, of London, has exhibits in various parts of the grounds. One is a continuous-current dynamo (which is eventually for the use of the Glasgow Corporation), designed to give 600 volts and 1920 amperes, at 230 r. p. m. It is coupled direct to a Willans & Robinson engine, and is erected in Machinery Hall near the company's main exhibit. In its own stand is shown a power transmission plant, operated by single-phase alternating current. It consists of a continuous-current motor, coupled direct to a single-phase, alternating-current dynamo, and various transformers for stepping the current up and down. There are also a number of motors for various uses, which are being driven by this current. In a pavilion on Machinery Avenue are exhibited machines and apparatus for railways and mining apparatus, as well as smelting works and collieries, consisting of pumps, motors, etc., etc. Interesting features are an electric crane and a complete exhibition of electric tramway apparatus, consisting of a Brill car and truck equipped with Schuckert motors. The company also exhibits its apparatus for underground conduit and a complete section of the new surface contact system, which was recently described in these columns. It also shows a motor with controlled for automobile purposes, and motors for almost every purpose, with all the necessary switchboard, resistances, etc., etc. It has erected a searchlight tower about 120 feet high and equipped it with a searchlight, which is operated from the foot of the tower. It is also interesting to note that the water chute is driven by a Schuckert motor.

THE BRITISH INSULATED WIRE COMPANY, LIMITED, has made a very comprehensive exhibit of electric wires, cables and all the various details necessary for underground work, and comprises many interesting features. A large collection of samples of the various types of paper insulated cable manufactured by the company, the most noticeable of which are: A 1 square inch triple cable, of which 27 miles have been supplied to the Glasgow Corporation, a 312-pair telephone cable, which is being laid at the present time for the Glasgow Corporation in connection with its municipal telephone department. A similar type of cable has been supplied to the British Government for the trunk line from London to Birmingham; .15 square inch three-core armored cable for 5000-volt three-phase working, of which 33 miles has been supplied to the Manchester Corporation, is exhibited, as well as a .14 square inch twin concentric cable for two-phase, working at 7500 volts. Another interesting cable is a concentric cable for working at 11,000 volts. This cable has been constantly at work for the last five years without a single fault at Deptford. The same type of cable has been put to work by the Metropolitan Electric Supply Company, Limited, in the trunk main from Willesden to London; 1.6 square inch single cable, as used by the Bradford Corporation. All the main cables for the exhibition buildings and grounds have been supplied by the British Insulated Wire Company.

MAVOR & COULSON, LIMITED, Glasgow, exhibit several of their combination sets, in conjunction with engine builders. A 500-hp generating set is shown, consisting of a slow-speed, continuous-current dynamo, and is exhibited jointly with Robey & Company, Limited, of Lincoln. The engine is of Robey & Company's cross-compound type, and the dynamo one of Mavor & Coulson's eight-pole generators. The dynamo, which is the largest yet built in Scotland, is mounted upon the crankshaft of the engine between its main bearings, and is designed to give an output of 630 amperes, at 550 volts at a speed of 90 r. p. m. The field magnets are of Charles Cammell & Company's steel, the armature disks are by Joseph Sankey & Son, the micanite by Bergtheil & Young, and the conductors by the Tele-



MOTOR WITH GEARED COUNTER-SHAFT.

graph Manufacturing Company, Limited. Another combination set is shown consisting of a 270-hp, high-speed generator, direct-connected to a three-crank, compound engine, made by Alley & MacLellan. The company also exhibits some fine illustrations of the concentric wiring, which it has made a specialty for many years.

THE TUDOR ACCUMULATOR COMPANY, LIMITED, of London, has a comprehensive exhibit, showing a complete battery composed of twenty-eight Tudor cells, type No. 102 LA 5, having a capacity of 140 ampere-hours. This battery is in working condition, and it is an example of the smaller batteries supplied by the company for isolated plant and of the method of mounting. The battery is regularly worked, being charged by a Bruce Peebles motor-generator, running from the Exhibition mains. Among the various sample cells exhibited by the Tudor Company, the most interesting is one of the type No. 130 LC 37, of which one side has been removed to show more clearly the internal arrangement. This cell is capable of giving an output of 1000 amperes, for four hours, and weighs, complete with acid, over 1¼ tons. Four batteries, each composed of 102 cells of this type, are already working in sub-stations of the Charing

Cross Company in London, and four more batteries of the same size are to be supplied to the same company before the end of the year, forming by far the largest battery plant in Great Britain.

THE BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, LIMITED, has, as noted, a fine pavilion, which is herewith illustrated inside and out, and which is certainly one of the leading electrical features of the Exhibition, being 75 ft. long and 30 wide. Its central item is a Westinghouse three-cylinder gas engine, 125 horse-power driving a standard railway generator, which furnishes current to all the lights and operative machinery of the pavilion at 125 volts. One main circuit from it goes to a Westinghouse rotary converter of 50-kw capacity, in which the 125-volt current is transformed into two-phase alternating at 400 volts, at a frequency of

FIG. 1.—BRITISH WESTINGHOUSE PAVILION.

60 periods, utilized for driving a 10-hp induction type motor. In turn this motor is belted to a small multipolar direct-current generator. The other main circuit from the larger generator goes to a motor-generator in which the current is stepped up to a pressure of 500 volts. The output of this combination unit is utilized for driving as a motor the largest dynamo in the pavilion, a Westinghouse 325-kw shunt-wound machine, shown attached to a Markham engine, which it turns as a load. Another prominent feature of the exhibit is a full-size Milnes trolley car, with Brill truck and West-

FIG. 2.—BRITISH WESTINGHOUSE EXHIBIT.

inghouse motors, controllers, switches, etc., of the type used on the Glasgow City Tramways. A notable point about this car is that it is equipped with an electro-magnetic brake of the Westinghouse Newell type. It consists practically of a magnet suspended by springs immediately over the track rail head, connected by a system of levers with the wheel-rim brake-shoes. Adjustments are so made that the thrust of the magnet on the track rail is taken up with an increased pressure on the wheel rims. The current is taken, of course, from the car motors running as generators. The proportion of track breaking to wheel-braking is finely variable to get the best effect without skidding. In conclusion it may be noted that the car has Sawyer-Man lamps, in regard to which a large, handsome sign makes itself conspicuous at one end of the pavilion.

KELVIN & JAMES WHITE, LIMITED, of Glasgow, have an exhibit, which consists of the switchboard controlling the distribution of electricity for light and power purposes to the whole of the exhibition. The board is arranged for the three-wire system, and panels are provided for twelve generators and eight feeders, dealing in all with 5800 electrical horse-power. The middle panel is fitted with Kelvin thistle-pattern feeder and dynamo voltmeters, a recording voltmeter, earth current recorders, etc., and is connected to the middle wire of

FIG. 3.—BRITISH WESTINGHOUSE EXHIBIT.

the system of distribution. Each dynamo has a positive and a negative panel, one mounted directly above the other. The positive panel is fitted with a Kelvin ampere gage and a main switch of the edgewise type, with carbon breaks. The negative panel is fitted with a Ferguson & White's automatic return current cut-out, with blow-out screens, the dynamo field regulator hand wheel, and a pair of sockets for a Kelvin paralleling voltmeter. Each positive and negative feeder panel is fitted with a Kelvin feeder log and an edgewise switch for 750 amps. All the panels are of polished white marble, supported by a steel framework. A polished teakwood molding is fitted on the top and sides, and the whole is surmounted by an electrically synchronized clock controlled by a regulator at the other exhibit of Kelvin & James White, Ltd., in the Main Avenue, consisting chiefly of optical devices, barometers, etc. This regulator also controls the clocks in the Kelvin feeder logs.

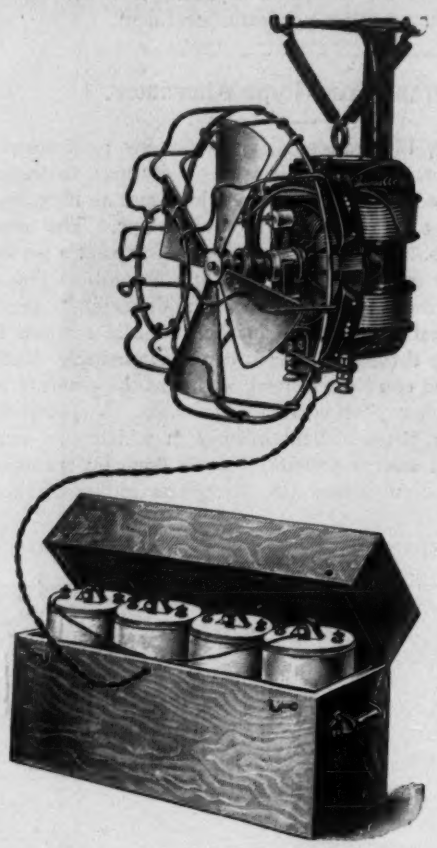
BABCOCK & WILCOX, LIMITED, of London, have a useful exhibit of their boilers which, in conjunction with others, are supplying steam for power purposes in the Machinery Hall. There are two water-tube steam boilers, each containing 5137 square feet of heating surface, and constructed for a daily working pressure of 160 lbs. per square inch, set together in one battery or nest. Each boiler is composed of eighteen sections of tubes, each section having twelve tubes from top to bottom, with an additional row of tubes constituting the Babcock & Wilcox patent Scotch furnace. These tubes are 4 inches in diameter and 18 feet long, and are connected at the front and rear to two steam and water drums 48 inches in diameter and about 23 feet long. Connecting these two drums is an extra steam chest 20 inches in diameter. These boilers are fitted with patent superheaters, as well as patent chain-grate stokers, designed for the most efficient and smokeless combustion of semi-bituminous fuel. In addition to the above, they are exhibiting a marine boiler built for 1000 indicated horse-power, and constructed for a daily working pressure of 200 lbs. per square inch. This is the type of boiler which has been supplied for war vessels and the mercantile marine.

THE ELECTRICAL CONSTRUCTION COMPANY, LIMITED, London, has an interesting space containing an electrically driven, triplex ram pump, exhibited in conjunction with Joseph Evans & Sons, of Wolverhampton; polyphase motors, direct-current motors, and one of the standard upright bipolar dynamos, made by the company, and

particularly intended for battery charging work and small lighting installations. A type of E. C. C. motors is made so as to allow for partial or complete enclosure, and an example of this style is exhibited. These motors are most extensively used as series-wound machines for crane and hoist operation and kindred applications, but as compound and shunt-wound motors, they form a most satisfactory motor, driving all classes of machine tools, etc.

THE WHEELER CONDENSER & ENGINEERING COMPANY exhibits one of its rectangular surface condensers, with 1230 square inches of cooling surface, with pumps, and a similar condenser of about one-quarter the capacity. There is also one 400-hp heater of the vertical type and lagged, and also one 10-hp heater of similar design. With the above is a model cooling tower of the company's fanless flue type, and one 8-inch centrifugal pump with 40-hp motor, and one 8-inch centrifugal pump with 6-inch x 6-inch vertical engine.

THE EDISON & SWAN UNITED ELECTRIC LIGHT COMPANY, LIMITED, of London, is exhibiting a 4-pole dynamo, built for an output of 520 amperes, at 250 volts, and coupled direct to a Browett & Lindley 200-hp engine. It also exhibits several small enclosed motors, 1-horse-power and 2-horse-power, driving various exhibits. Their special features are perfect enclosure, high efficiency, perfect sparklessness with fixed brushes and the small amount of attention required.



BATTERY FAN MOTOR.

ISIDOR FRANKENBURG, LIMITED, of Manchester, has gathered together an interesting exhibit of specialties in insulated wires and cables. Their cable stand is situated in Machinery Hall, where is shown a cone over 17 feet high, built up of fifteen drums of cable. At the base is 37-12s., 2500-megohm steel-wire armored cable, and at the top 1-18s., 600-megohm wire. There is also exhibited two small piles of wire and cable, one of 600 megohn and the other of 2500 megohm grade, coiled up and wrappered in the usual manner for shipping. A sample case containing sections of various sizes and classes of cable, large and small, with lengths of the respective cables stripped back at one end to show method of construction, and two sample boards of vulcanized india rubber wires and cables.

Battery Fan Motor Outfit.

The illustration shown above is of a new suspension battery fan motor outfit now being placed on the market by the Edison Manufacturing Company, of New York. This outfit includes an Edison suspension battery ball-bearing motor with a nine-inch fan and four Edison-Lalande cells, together with the necessary connecting cords, etc.

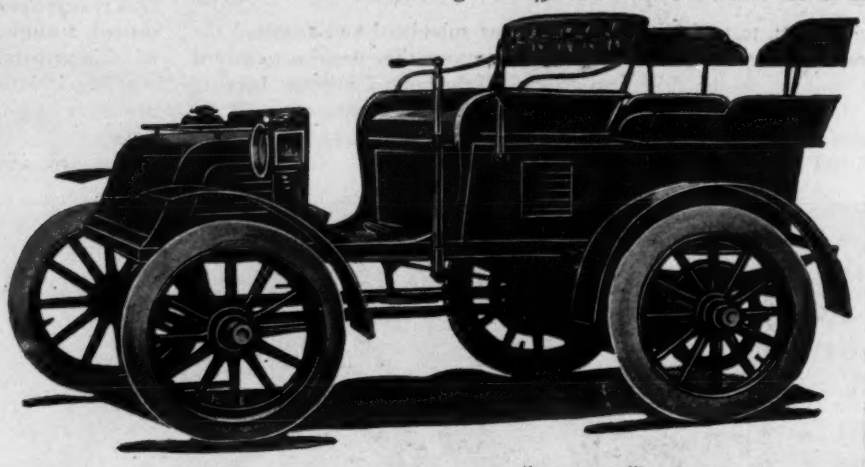
The motor, as will be seen, is suspended on springs from a wall bracket, this method of suspension rendering the operation of the motor noiseless. The outfit is, therefore, exceptionally well suited for use in bedrooms, sick-rooms, etc. One charge of the battery will, it is stated, operate the outfit 150 hours.

The motor is of the Pacinotti ring type, open field. The armature shaft is mounted on ball bearings so as to reduce the frictional loss. The diameter of the armature is 3¾ inches, and the torque of the motor is quite noteworthy for its size. The speed, when it is operated by four Edison-Lalande cells, with fan attached, is about 850 r. p. m.

A New Electric "Tonneau"

The attractive automobile illustrated herewith is what is known as a "tonneau." It is rather of the gasoline type in appearance, owing to the box in front, which in this instance is used for carrying part of the battery. As a standard type it is furnished with an operator's seat, accommodating comfortably two passengers, with a tonneau body, which furnishes room for two additional passengers. This tonneau is removable, and in its place may be substituted either a surrey seat for two passengers, or a rumble seat for an attendant, or a hamper for light luggage, while, if desired, the rear space can be left vacant to hold heavy luggage.

There is a double motor equipment, and as already noted, the battery is distributed over both the front and the rear axles, equalizing the weight and increasing the capacity for hill climbing. All the four wheels are of the same size, 32 inches, with 3½-inch pneumatic tire, and the body hangs low, rendering it easy to mount and dismount. The total net weight is 2490 lbs. There are 1100 lbs. of battery, and 400 lbs. of body. Each motor is of 1¾ horse-power. There are 40 cells of battery and a maximum speed of 14 miles an hour can be reached, the radius being 40 miles. This Columbia electric tonneau is built by the Electric Vehicle Company, of New York City.



ELECTRIC "TONNEAU."

A Telephone Test at Reading, Pa.

Several weeks ago the Schuylkill Valley Telephone Company, of Allentown, Pa., awarded the American Electric Telephone Company, of Chicago, the contract for supplying the Reading telephone exchange system with apparatus comprising switchboards, power board, cross-connecting boards, storage batteries, chief operator's and wire chief's desk and a full equipment of Burns' terminals and central energy telephones. Before placing the order for the telephone apparatus required at Reading, the directors of the Schuylkill Valley Telephone Company sent notices to leading telephone manufacturing companies requesting them to submit bids and samples of their apparatus, and they responded by forwarding a full line, and also arranged to have representatives present during a test of the apparatus submitted. In order to facilitate the making of these tests, each manufacturing company submitted a complete switchboard system in miniature together with a pair of telephones, and when a given system was under consideration a test would be made from telephone to telephone through the switchboard containing the circuits which would be used in the system proposed. In order to make the test a fair one, arrangements were made to use a loop cir-

cuit from Allentown to Wilkesbarre, and another loop from Allentown to Hazelton. These circuits gave the desired conditions for testing under actual service conditions.

After the engineers for the Schuylkill Valley Telephone Company

DESK TELEPHONE.

had made a test of all of the apparatus submitted and reported the results of these tests to the board of directors, they decided to award the contract to the American Electric Telephone Company, because of the high efficiency and superior mechanical construction of its transfer multiple central energy switchboard as well as of the powerful and distinct articulation of its telephones.

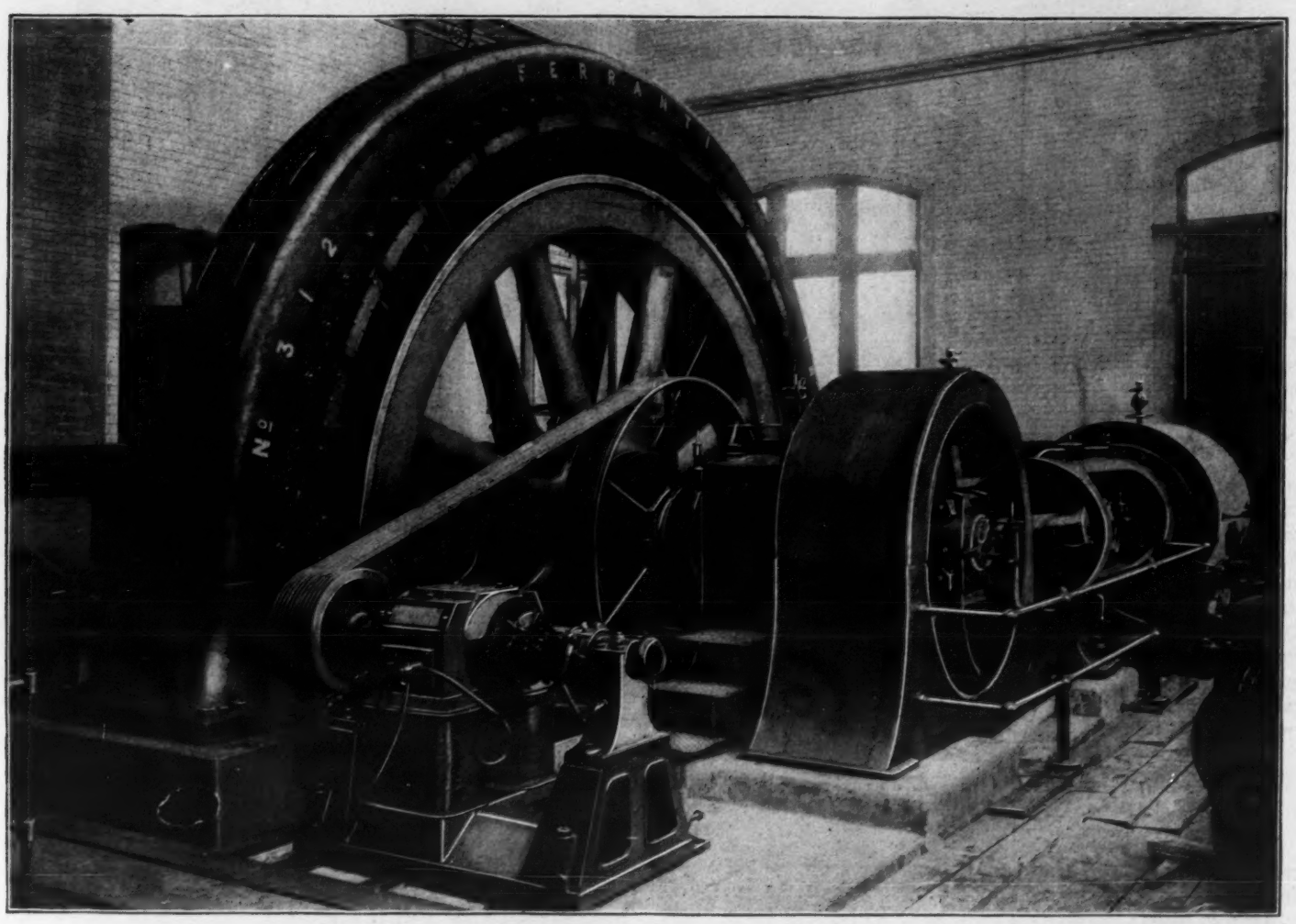
Desk Telephone.

The neat and handsome form of Bell type of desk telephone herewith illustrated is being introduced by Haines & Noyes Company, of Chicago. It is made for use on bridging, series, central energy or intercommunicating work. It has a heavy cast base, with an upright of copper, all exterior metal parts being heavily nickeled. The contacts are in the base and are platinum pointed, besides being free from dust or corrosion from exposure, they virtually cannot be broken or jarred loose. The terminal cords are under one woven cover of silk or worsted. The transmitter front and parts are of solid brass, with a special transmitter of liberal volume of sound and sharp, clean articulation. The bipolar pony receiver has permanent adjustment, with a water shrunk hard rubber cell. The induction coil is silk-wound, with fiber ends, and is mounted on a fiber base with nickel binding posts. This instrument is furnished either with or without a button in the base, and separately, or with intercommunicating plug box, or other apparatus pertinent.

Ferranti Iron-Type Alternator.

The accompanying illustration shows a 600-kw slow-speed Ferranti iron type alternator similar in general features to those first introduced in England by Mr. Ferranti so long ago as 1893, being of the revolving field and stationary armature type. The machine, which runs at 94 r. p. m., and gives a voltage of 2100 at a periodicity of 50, is one of four erected within the last 12 months. The armature is 18 ft. inside diameter, and the outside diameter of the frame is 23 ft. The laminations are held in the frame in sections by insulated bolts passing through the back of the stampings. Each section is detachable and complete in itself so far as the winding is concerned, spanning over a pitch equal to two poles. A special feature of this armature is the excellent manner in which the armature winding is insulated and protected. This is done by enclosing the armature winding as it leaves the stampings in strong ambroin boxes.

The armature sections are built up of laminated charcoal iron



FERRANTI IRON-TYPE ALTERNATOR.

plates papered on one side, and separated at intervals by ventilating spaces across the width of the armature. Tunnels are punched on the inner edge and the winding, which is of stranded copper cable double cotton-covered and braided, is wound through these tunnels, being insulated from the stampings by strong micanite tubes. The armature coils are conencted in series round the machine.

The frame is of cast iron of massive section, and is supported on box section girders. The field magnets, 64 in number, are of high permeability cast steel securely held to the rim of the flywheel. The field winding consists of one coil per pole of flat strip copper wound on edge, thus exposing every turn for cooling. The coils are insulated from the magnets by layers of insulating material wound on the body of the magnets, and from the wheel by stout fiber washers. The field is, of course, excited in series, the exciter as shown by the illustration being driven from a rope pulley on the engine shaft. The engine to which the alternator is connected was manufactured by Daniel Adamson & Co., of Hyde.

A New Testing Set.

For some time there has been on the English market an instrument for indicating directly the value of a resistance, known as the Evershed ohmmeter. This instrument is particularly adapted to the

OHMMETER.

measurement of high resistances, and is of importance in testing the insulation of both ærial and underground cables, dynamos and wiring installations of every kind. On account of the high rate of import duty, this testing set has had but a limited sale in the United States and its usefulness is not widely appreciated. The growing need in this country for a moderate priced apparatus of this type has induced the firm of Queen & Company to secure the American rights for the manufacture of this instrument, and they are now prepared to furnish promptly a variety of these ohmmeters suitable for testing resistances from 100 ohms up to 50 megohms.

The testing set as shown in the illustration consists of two parts, the one being the generator, which is in reality a small dynamo. This is capable of being driven at a high rate of speed and can be wound so as to produce voltages ranging from 10 volts, used with the testing set for measuring low resistances, up to 1000 volts, used for measuring the highest resistances. The weight of the generator is only a few lbs., and the effort required to drive it is very small, the friction in the bearings being reduced to a minimum by the use of rollers, and the collecting brushes being in the form of elastic disks rolling in contact with the ring segments of the commutator, a device which lessens friction to almost a negligible extent and at the same time insures perfect contact at all speeds. The driving handle is permanently fixed on the axle, so that it is impossible for it to become mislaid. It is held in position for turning by means of a spring catch, and when not in use is turned back in a recess in the wooden case. The generator is also provided with a spring drum inside the case on which a twin flexible cord is coiled and provided with a catch device so that it can be held at various lengths. The two ends of the flexible cord are attached to the connector for clamping under the ohmmeter terminals.

The indications of the ohmmeter are produced by the action of three sets of coils on an astatic needle. This needle is also magnetized by the current from the generator, and therefore renders the reading independent of the direction of the testing current, that is, reversal of the connections between the instruments, or the direction of the rotation of the generator, does not injure the ohmmeter in any way nor affect the accuracy of its readings.

This set has the great advantage that the simplicity of its construction allows it to be put in the hands of the ordinary workman, who can secure as accurate results as one having a great deal of experience in testing work. Furthermore, the potential which is applied to a cable or line of wires under test is the same as, or greater than, would be the case in actual operation. In this respect, it is said, the plan is preferable to the ordinary method of testing now in vogue, of using a high sensibility galvanometer and a few cells of battery. In this latter method the cable is only subjected to a pressure of a few volts, not sufficient to break down a weak point which might, however, be broken down by a considerably less voltage than would be ordinarily used on the line. A generator can be employed which produces sufficient voltage to make such a test properly.

Abroad, this set has, it is stated, come into general use for its simplicity, convenience and accuracy, it being adopted by nearly all the leading supply houses, wiring contractors and dynamo builders.

Northwestern Convention Notes,

As usual at Northwestern Electrical Association conventions, the supply men were very much in evidence, in fact, much more so than the electric light and power delegation, as will be seen by the following notes:

RICHARD SMITH, of Keelyn & Smith, Milwaukee, represented his firm.

GEORGE WHITE, of Macomber, White & Company, Chicago, was on hand.

JULIUS ANDRAE SONS, Milwaukee, were represented by Mr. Schmitbauer.

THE H. T. PAISTE COMPANY was represented by Edward A. Jenkins, of Chicago.

THE BASEBALL GAME, Wednesday afternoon, was a thrilling affair to those who participated.

THE MCROY CLAY WORKS, Brazil, Ind., was represented by General Manager Kirkpatrick

THE SUPPLY MEN were entertained with a dance at the Lake View Beach Hotel, Wednesday evening.

THE ILLINOIS ELECTRIC COMPANY had its interests looked after by C. W. Bacon, its Wisconsin representative.

SECRETARY THOMAS R. MERCEIN, of Milwaukee, was as active as ever both in and out of convention sessions.

THE SAWYER-MAN ELECTRIC COMPANY was represented by Geo. A. Nellis, acting manager of the Chicago office.

KURTS & ROOT, of Appleton, Wis., and Evans Almiral & Co., Chicago, were admitted as associate members.

WILLIAM D. KURTZ, of Kurtz & Root, consulting electrical engineers, Appleton, Wis., was one of the late arrivals.

THE AMERICAN CIRCULAR LOOM COMPANY had Western Manager Thomas G. Grier and the red trade mark much in evidence.

W. C. PHELPS, of the Phelps Company, of Detroit, maker of incandescent lamps, was present during one day of the convention.

"G. I." RAYMOND.

JOHN W. BROOKS, manufacturers' agent, 303 Dearborn Street, Chicago, was present in the interests of the various companies he represents.

THE ELECTRICAL PRESS, outside of the ELECTRICAL WORLD AND ENGINEER, was represented by Chas. K. Thomas, W. F. Collins and F. L. Perry.

GEO. J. CADWELL, sales manager of the motor department of the Christensen Engineering Company, went up from Milwaukee to attend convention.

THE ELECTRICAL WORLD AND ENGINEER was represented by J. V. S. Church, western manager, and James R. Cravath, of the editorial staff, both of Chicago.

M. B. AUSTIN & COMPANY, of Chicago, sent A. Meinema, who was on the ground early and helped receive the Chicago and Milwaukee crowd on its arrival Monday evening.

THE GREGORY ELECTRIC COMPANY, of Chicago, was represented by R. H. Watson, of the sales department, whose sterling gentlemanly qualities make him a favorite everywhere.

HUSKIES.—Two husky-looking country lassies, Misses Upham and Cadwell, rode in from the woods on a boneshaker to attend the Thursday morning session, but were rather late.

EVANS, ALMIRALL & COMPANY, owners of the Evans exhaust hot water heating system, 1001 Monadnock Block, Chicago, were represented by C. Locke Etheridge, mechanical engineer.

THE COLUMBIA INCANDESCENT LAMP COMPANY, of St. Louis, was represented by the manager of its northwestern office, James B. Coale, of Minneapolis, who came all the way from South Dakota to attend.

THE WAGNER ELECTRICAL MANUFACTURING COMPANY and BULLOCK ELECTRICAL MANUFACTURING COMPANY were represented by Fred. Foster, manager of the Chicago joint sales office of the two companies.

HARRY BYRNE, the Wisconsin representative of the Western Electric Company, joined the Chicago party at Milwaukee and was warmly welcomed. A good singer and story teller, he added much to the enjoyment of the crowd.

GRIER'S special dinner card, which was served along with other things at the Lake View Beach Hotel, Thursday noon, was a piece of "Tom" foolery enjoyed more than the dinner itself, from the Mercein radishes down to the Schmitbauer toothpicks.

THE DEARBORN DRUG & CHEMICAL WORKS, of Chicago, sent some good luck pieces to be distributed by James W. Harkins, its Illinois and Wisconsin representative. These pieces served to remind that little savings make big dividends.

THE BRYAN-MARSH COMPANY had reason to especially congratulate itself on its representation. Guy V. Williams, of Minneapolis, manager of its northwestern district office, read the paper on "Incandescent Lamps" before the Association Wednesday afternoon.

O. C. LITTLE, president of the O. C. Little Pulley Coating Company, came down from his home at Menasha, Wis., bringing his dynamometer testing model for demonstrating the difference in the pulling power of a belt when running on coated and non-coated pulleys.

THE FORT WAYNE ELECTRIC WORKS, which do an extensive business among delegates to Northwestern conventions, had their Chicago manager, W. S. Gall, and Frank McMaster in attendance. These gentlemen brought along an exhibit of Fort Wayne apparatus.

CENTRAL STATION MEN attending the convention were: G. C. Gum, Delevan, Wis; John Fox, Manitowoc, Wis.; E. L. Debell, Sheboygan, Wis.; T. F. Grover, Fon du Lac, Wis. But they did not seem particularly lonesome, as each one had 25 supply men paying him attentions.

AT THE theatrical entertainment, to which the convention visitors were invited Thursday evening, the occasion was taken to present Mr. James Wolff, of the New York Insulated Wire Company, with a loving cup as a token of the high esteem in which he is held by the supply men of the Northwest.

OLD-TIMERS were agreed that there was more horse-play to the square inch at this convention than at any other electrical gathering ever held on American soil. Whether this is a subjct for congratulation or indignation is a point the old-timers are now deciding. "Horse" play is not the right term, according to some of them.

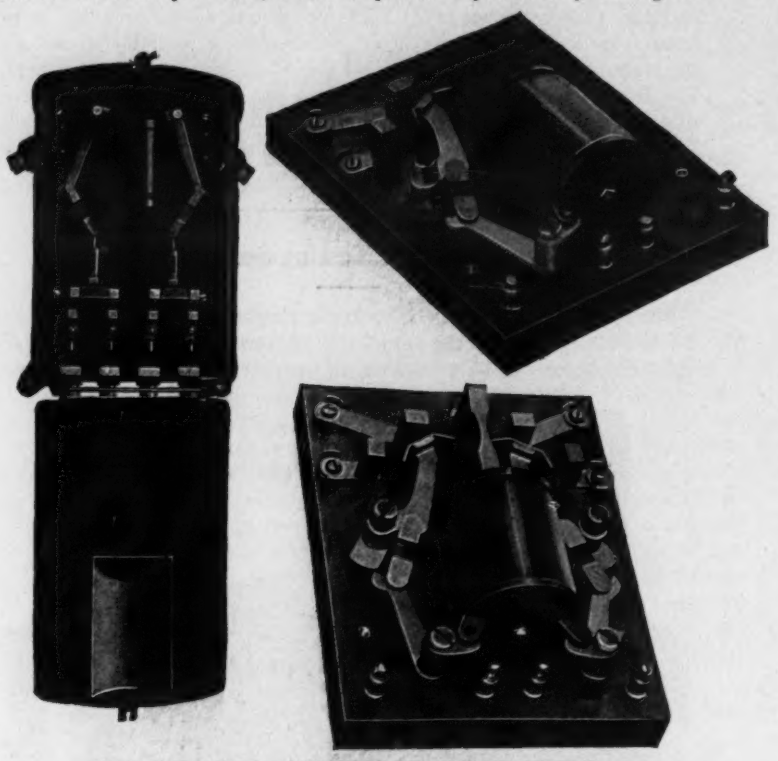
THE ELECTRICAL APPLIANCE COMPANY, of Chicago, sent W. P. Upham to look after its interests. Mr. Upham distributed porcelain bushings and a dice block bearing on four of its sides the various transpositions of ohms law, and with the mark of "Brunt," East Liverpool, Ohio, maker of porcelain electrical goods, on the other two sides.

THOMAS FERRIS, of the General Electric Company's Chicago office, was among the supply delegation. He had with him some samples of the new 4-candle-power, 106-volt lamp on standard screw base which promises to offer quite an improvement over the old scheme of putting a number of low candle-power lamps in series on signs and display lighting.

JAMES WOLFF, Chicago representative of the New York Insulated Wire Company, organized the Chicago delegation and secured a special car on the train leaving Chicago and Milwaukee Monday evening. Mr. Wolff is always one of the leaders among the supply men at these conventions, but bears the place of honor awarded him by common consent with becoming dignity.

Remote Control Switches.

The accompanying illustrations show a type of switch made by the General Electric Company for a system of remote control in connection with arc lamps, motors, groups of incandescent lamps, etc. The switches are so constructed that any number up to 10 can be placed in series and operated by a single-pole double-throw switch at the controlling point. The switch is particularly adapted for use by central stations which may have a number of customers who, on account of cheaper rates, desire to purchase power only during cer



FIGS. 1, 2 AND 3.—SWITCHES FOR REMOTE CONTROL.

tain hours. In the case of a number of large transformers banked for power or light distribution, the losses in some of the transformers may be avoided during the light load period by cutting them out and leaving only a sufficient number to carry the load. The switches may be readily arranged to cut out first the transformer secondaries, and then the primaries.

If multiple arc lamps are used for city lighting, the lamps can be run directly from the main distribution circuit by placing one of the small switches at each arc lamp or group of arc lamps, and arranging in series all switches controlling certain portions of the system.

The switches are furnished with an iron box, as shown in Fig. 1, or unenclosed, as shown in Figs. 2 and 3. Fig. 1 shows a switch of the double-pole type, and having a capacity of 100 amperes. Fig. 2

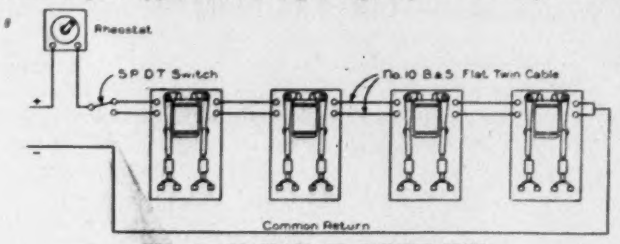


FIG. 4.—DIAGRAM OF CONNECTIONS.

is a single-pole switch, and Fig. 3 a double-pole switch, the capacity of each being 25 amperes.

The method of connecting is shown in Fig. 4. A rheostat is placed in the circuit merely to limit the flow of current in case less than the maximum number of switches is used with a certain voltage. For the conducting wire, No. 10 B. & S. flat twin cable may be employed, while for the common return a No. 10 B. & S. single wire is employed, or either leg of a two or three-wire system. If the switches are to be used in connection with an alternating-current circuit, they may be operated by the exciter current. To open all the switches the single-pole double-throw switch is thrown one way for an instant only, and then opened. The switches are closed by similarly manipulating the controlling switch, but in opposite direction.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—In the money market the following quotations were recorded at the close of the week: Six per cent, nominally, for call money, the rate having reached as high as 15 per cent after the closing of the doors of the Seventh National Bank by the Controller of the Currency on Thursday. Most of the loans, however, were made at 6 or a little above that figure; 4 per cent is quoted for time money for all periods. Mercantile paper is quoted at 3¾ a 4¼ per cent for 60 to 90 days' indorsements; 4 a 4½ for choice four to six months single names, and 5a5½ for others. The stock market was somewhat disturbed last week by the troubles of the Seventh National Bank and the failure of a prominent brokerage house, but nothwithstanding these influences it behaved exceeding well. Continued fair crop prospects, active business conditions and railroad earnings, which present increases even over the very large total of a year ago, rendered the market immeasurably insensible to any adverse outside influences. There was an apparent lack of outside interest, and the support extended by bull pools and large interests to various specialties was notable, although there is general confidence in "The Street" that better speculative conditions will prevail after July 1, provided there are no further unsettling incidents in banking circles. The question of dividends on United States Steel stocks occupied much interested attention, but nothing definite in this direction was developed. Among the traction stocks Manhattan was firm, but Brooklyn Rapid Transit was most active, reports of good earnings being prevalent, and the covering of shorts giving the stock a certain measure of support. The sales of this stock aggregated 108,750 shares, the result of the week's trading being a net gain of ¼ point. Metropolitan Street Railway was not particularly active, the sales for the week amounting to 43,300 shares, the closing price being 174¾, ex dividend, which represents a net gain of 2 points. General Electric was very firm, the trading was restricted in volume, only 4250 shares having changed hands during the week. The price continues to advance, being 267 at the close—a net gain of 7 points. Western Union was the exception in the electric list, suffering a net loss of three-eighth point on sales of 11,110 shares. Dealings in outside securities were not marked by any features of prominence. Most of the stocks remain at practically unchanged quotations. The exception was Electric Boat, of both issues, common losing 5 points and preferred 3 points. Electric Vehicle, both common and preferred, advanced 1 point each. The following lists show the closing quotations at the four points named:

NEW YORK.

	June 2.	June 29.		June 2.	June 29.
General Electric	260	267	Electric Vehicle	8	9
Brooklyn Rapid Transit	82½	82¾	Electric Vehicle, pfd.	16	17
Metropolitan Street Ry.	174½	174¾	General Carriage	1⅞	2
American Tel. & Cable.	100	—	Illinois Elec. Veh. Tran.	⅝	⅝
Western Union Tel.	94¼	93⅜	Hudson River Tel.	120	120
American Dist. Tel.	—	34	N. E. Elec. Veh. Tran.	3	3
Commercial Cable	—	184	N. Y. Elec. Veh. Tran.	14	13½
Electric Boat	22	17	Tel. & Tel. Co. of Am.	5	4
Electric Boat, pfd.	50	47	N. Y. & N. J. Tel.	173	173
Electric Lead Reduc'n	3	2½			

BOSTON.

	June 2.	June 29.		June 2.	June 29.
New England Telephone	—	*140	Erie Telephone	55½	50
Mexican Telephone	2½	2½	General Electric, pfd.	—	—
Westinghouse Electric	—	*70¾	Am. Tel. & Tel.	160½	156
Westinghouse Elec., pfd.	78	*80	Boston Electric Light	—	—

PHILADELPHIA.

	June 2.	June 29.		June 2.	June 29.
Electric Storage Battery	67	77	Philadelphia Electric	5½	5½
Elec. Storage Batt'y pfd.	68	75	Pa. Electric Vehicle	1	1
Elec. Co. of America	8	7¼	Pa. Elec. Veh., pfd.	1	1
General Electric Auto	—	—	Am. Railways	41½	42

CHICAGO.

	June 2.	June 29.		June 2.	June 29.
Chicago Edison	177	177	Chicago Telep. Co.	275	*276
Chicago City Ry	206½		Union Traction	19½	19
National Carbon	18	16	Union Traction, pfd.	58	60
National Carbon, pfd.	87	86	Northwest Elev. com.	47	47

*Asked.

BROOKLYN RAPID TRANSIT.—The lease of Brooklyn Union Elevated to the Brooklyn Heights Railroad Company has been filed with the Secretary of State, to expire June 30, 2900. The lessee covenants to pay annually in quarterly installments all reasonable expenses of maintaining the corporate existence of lessor company, not exceeding $3,000 a year, and the lessee further agrees, as part of rental, to pay to the lessor company before each Sept. 30, after June 30, 1902, until and including Sept. 30, 2900, all of the annual earnings received by the lessee from the operation of the Brooklyn Union Elevated Railroad property after deducting therefrom the several amounts specified, as part of rental, these net earnings after deductions aforesaid, shall not be less for each of the fiscal years ending June 30, 1902, 1903 and 1904, than $150,000, or less for each of the fiscal years 1905 and 1906 than $200,000, or less for each year thereafter and during the continuance of the lease less than $250,000.

DIVIDENDS.—The Edison Electric Illuminating Company, of Savannah, has declared the regular semi-annual dividend of 3 per cent, payable July 1. The Cleveland Electric Railway Company has declared the regular quarterly dividend of 1 per cent, payable July 5. The Washburn Wire Company has declared a dividend of 1¾ per cent on its preferred stock, payable July 1. Directors of Brooklyn Union Elevated Railroad have declared a dividend of 2 per cent on its preferred stock. Brooklyn, Queens County & Suburban Company directors declared dividend of 1 per cent, and Seabeach directors declared a 1 per cent dividend, all payable June 29. In each instance these are initial dividends. Brooklyn Heights road will hereafter guarantee interest and principal of Brooklyn Union Elevated 1st mortgage bonds and Kings County Elevated 4 per cent bonds. The Philadelphia Company, of Pittsburg, has declared a dividend of 1½ per cent on its common stock, payable July 20.

BERGEN COUNTY COMPANY STOCK.—As the result of the failure of the Seventh National Bank and of Henry Marquand & Co. last week, there were sales under the rule at the Stock Exchange of 300 shares of Gas & Electric Company, of Bergen County, stock at 30 cash, and 100 shares at 32 cash. The last previous quotation, regular way, was 101a101¼. The sales are supposed to be for the account of Henry Marquand & Co. Other sales have been made under the rule, but at normal prices. The stock of the Gas & Electric Company, of Bergen County, has since rallied. It is understood that both the Standard Oil Company and the United Gas Improvement Company are seeking control of the property. The company has an excellent business and territory, and has been admirably conducted.

A WILD RUMOR.—Some stock exchange reports are crazier than others. The subjoined is one of them, printed by leading Wall Street papers. The General Electric Company is on excellent terms with Mr. Edison, and proposes to stay so. Here is the report: Certain developments of late seem to foreshadow an active contest between the General Electric Company and the Edison Storage Battery Company, recently incorporated in New Jersey, with Thomas A. Edison as president. It is understood that the General Electric Company is about to close negotiations which will give it control of the storage battery invented by Mr. Strowger, of Rochester, N. Y. And more to the same effect.

CENTRAL UNION ASSESSMENT.—Central Union Telephone stockholders are not taking kindly, it is said, to the proposed assessment to put the company on a sound basis. It is hardly probable that the shareholders will accede to an assessment, and as the laws of Illinois prohibit a forced assessment, the only course open is to issue 4 per cent debenture bonds. The stock of this company shows particular strength in view of this condition. The American Bell owns half the six million of stock.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, Ohio, has declared its regular quarterly dividend. James C. Marshall, for five years auditor of the Farmers' & Shippers' Leaf Tobacco Warehouse Company, was elected assistant treasurer.

ST. LOUIS LIGHTING.—Messrs. Battles, Hays & Harrison, of New York City, have sold a controlling interest in the Imperial Electric Light, Heat & Power Company, of St. Louis, to Messrs. Bertron & Storrs.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade, crop and industrial developments last week were largely favorable, according to *Bradstreet's* summary, temporarily firmer money, owing to July interest disbursement preparations, and slight financial troubles, due to improper banking methods, not detracting from the generally satisfactory and confident feeling with which the half year in business closes. Iron and steel show few notably new features. The price of Bessemer pig has been definitely fixed for the third quarter of the year, and, it is thought, heavy business has been done recently. Foundry pig is rather quiet; the machinists' strike has hurt this line of business, but this trouble appears to be subsiding. American steel billets are

being offered on the British markets at very low prices. This fact is taken to indicate that American manufacturers are in the export business to stay. All the building trades are active and large quantities of materials are passing into consumption. The hardware trade makes very favorable reports. Anthracite coal is without change, although there were exceptionally heavy movements last week, for this season, due, it is thought, to the probability of continued advance in price. The failures for the week, as reported by *Bradstreet's*, numbered 196, compared with 188 the week previous, and 185 the same week a year ago. In the metal market, copper was quiet and dull; manufacturers are busy, but not buying much. The leading producers are holding firm, but what little business was done was taken by others at concessions. Quotations are: 16¾c. for Lake; 16¼a16¾c. for electrolytic in cakes, wire bars and ingots; 16a16⅛c. in cathodes; 16¼c. for casting copper.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the Port of New York for the week ended June 19: Antwerp—43 packages electrical material, $2,726. Amsterdam—4 cases electrical material, $54. Aberdeen—6 packages electrical machinery, $500. Brazil—21 packages electrical material, $390. Bremen—1 package electrical machinery, $327. Bristol—11 cases electrical machinery, $500. Berlin—1 package electrical machinery, $275. British East Indies—1 package electrical material, $57. British Australia—14 packages electrical material, $2,080. British Africa—11 cases electrical material, $3,384. Brussels—1 package electrical material, $100. Barcelona—2 packages electrical machinery, $102. Belfast—15 cases electrical material, $990. British West Indies—16 packages electrical material, $371. Cuba—35 cases electrical material, $375. Central America—1 case electrical material, $13. Copenhagen—1 case electrical material, $26. Dundee—3 packages electrical material, $150. Ecuador—2 packages electrical material, $33. Glasgow—20 packages electrical material, $1,193; 22 reels cable, $10,669; 25 packages electrical machinery, $2,000. Havre—49 cases electrical machinery, $25,221; 14 packages electrical material, $1,688. Hamburg—1 package electrical machinery, $10; 71 packages electrical material, $8,087; 12 auto vehicles, $1,275. London—78 cases electrical machinery, $2,365; 144 cases electrical material, $4,756; 9 motor vehicles, $3,780. Liverpool —24 packages electrical machinery, $2,000; 56 packages electrical material, $2,858. Manchester—3 cases electrical material, $1,365; 543 packages electrical machinery, $60,323. Moscow—1 case electrical instruments, $90. Mexico—88 cases electrical material, $710. Newcastle—2 packages electrical material, $100. Preston—20 packages electrical material, $900. Peru—1 package electrical material, $70. Southampton—3 cases electrical machinery, $490; 25 packages electrical material, $894. U. S. Colombia— cases electrical material, $50; 4 cases electrical machinery, $700. Venezuela—3 packages electrical material, $33. Walsall—14 packages electrical material, $559.

MR. JAMES G. BIDDLE, Stephen Girard Building, Philadelphia, has just taken a very important order covering the instrument equipment of a new laboratory about being established in New York City by the Lamp Testing Bureau, which operates under the auspices of the Association of Edison Illuminating Companies. The experts of the Lamp Testing Bureau as well as its president, Mr. John W. Lieb, Jr., gave the subject most careful attention with a view of securing apparatus of the highest quality whether manufactured in America or Europe. Price was a secondary consideration, and Mr. Biddle's bid was not the lowest one received by any means. The order comprises a large amount of apparatus manufactured by Morris E. Leeds & Co., Philadelphia. Among the more important items are an Anthony type resistance box and Wheatstone bridge, Leeds standard laboratory potentiometer with volt box and low-resistance standards, Reichsanstalt type photometer, special portable potentiometer, special resistance box of about 100,000 ohms, Leeds portable testing set, Rowland electro-dynamometer with shunt box, D'Arsonval galvanometers, etc. In addition the order comprised some Weston semi-portable laboratory standard instruments, Weston standard cells and a few foreign instruments, such as Weber portable photometer, Heffner lamp with Reichsantalt certificate, special Lummer-Brodhun photometer screen, etc. At first, it is said, the officers of the Lamp Testing Bureau were disposed to place the entire order abroad (with exception of the Weston instruments, of course), so that it is specially gratifying that instruments made here were selected in almost every case.

BROWNE & FROTHINGHAM, of New York City, who act as export representatives of certain large manufacturers, have recently been asked to furnish estimates on various improvements now being considered by one of the Japanese railroads for an addition to their shops, which it is estimated will mean an expenditure of some $25,000. When the business is finally ready to place, which it is expected will be along this fall, the orders will come through one of the several export houses in this city doing business with Japan. The machinery in question covers two 30-ton electric traveling cranes of 60-ft. span, and having a lift of 25 ft., and we understand that figures relating to the supply of such equipment are being given by request by Pawling & Harnischfeger, of Milwaukee, Wis., and the Brown Hoisting Machinery Company, of Cleveland, Ohio. Full particulars have also been furnished the same Japanese road on three 100-kw generators, 450 r. p. m., and a number of 10, 15 and 24-hp motors as made by the Milwaukee Electric Company, of Milwaukee, Wis. The switchboard proposed is to be furnished by Geo. F. Rohn, of Milwaukee. All this is additional evidence that the Japanese are becoming more and more alive to the fact that modern first-class appliances are the most economical in the long run.

MR. G. H. WALBRIDGE, of the New York electrical engineering and contracting firm of J. G. White & Co., has just returned from a two months' trip to Europe, where he went for the purpose of conferring on some important electrical matters, with the directors of J. G. White & Co., Limited, of London, which concern has recently secured some large contracts for the equipment of electric lighting and traction plants in both Australia and New Zealand. Some substantial contracts have just been awarded to American manufacturers in connection with the Kalgoorlie Tramways Company, Western Australia. The Pennsylvania Steel Company has obtained an order for 1200 tons of steel girder rails, the J. G. Brill Company is to furnish 20 cars, while the General Electric Company has been allotted the order for the requisite motor equipments. No contracts will be let for power house equipment as all the electrical energy necessary for the operation of the tramway system will be derived from the power plant now under course of construction at Kalgoorlie. That generating station was primarily intended to supply power to drive machinery in the mines located in that neighborhood.

DECORATIVE ART IN ITALY.—One of the most interesting of the exhibitions to be held in the near future is that entitled the International Exhibition of Modern Decorative Arts, which will take place in Turin, Italy, next year. The commissioner general for the United States will be General L. P. di Cesnola, the well-known director of the Metropolitan Museum of Art in New York City. The programme for the exhibition is excellent, and there are several clasess in which America should be able to distinguish itself. Reproductions are barred, and only original work will be admitted. Lighting and warming apparatus and fixtures are necessarily included, as well as lanterns, lamp-posts, standards, etc., for exteriors and for use on the streets.

UNITED STATES CARBON COMPANY.—A meeting of the directors of the United States Carbon Company will be held in the near future, when the company will probably be reorganized. At that time the capital will be increased and arrangements will be made for the expansion of the plant, which is too small to take care of the present business. W. D. Sayle, at present receiver for the company, states that there are orders enough on hand to keep the plant running full time to July 15, and there is a large amount of business in sight. The first disposition on the part of the directors and stockholders was to sell the plant, but this has been succeeded by the feeling that it will prove a profitable investment to put more money into the business.

MR. CHRIS NEILSON, of the American contracting firm of Clarkson & Co., Vladivostock, Russia, is now in this country for the purpose of purchasing considerable quantities of electrical machinery, etc. He is at present negotiating with local parties with a view to the supplying of a large electric lighting and power plant for the Russian Government docks now in course of construction at Vladivostock. The equipment will include four 150-kw generators direct connected to engines, also some 20 motors of various sizes, cranes, etc. The Jeffrey Manufacturing Company, of Columbus, Ohio, has already received a fair sized order for conveying machinery. Mr. Neilson is stopping at the Astor House.

STEAMSHIP LIGHTING.—In the new steamship "Lyra," of the Boston Tow Boat Company, the installation of electric lights is remarkably complete, including even the holds, so that darkness may not interfere with loading and discharging cargo. The dynamo and engine—forming a compact generating unit—were designed and built by the B. F. Sturtevant Company, of Boston, Mass.

WESTINGHOUSE, CHURCH, KERR & CO., of New York City has received an order for 25-hp junior automatic engine direct connected to a 15-kw Westinghouse generator, switchboard, wiring, 150 incandescent lamps, five arc lamps, etc., which will be shipped to Brazil, where the plant will be utilized for lighting a hotel at Para.

WORK RESUMED IN SPRAGUE JERSEY FACTORY.—The Sprague Electrical Works at Watsessing, N. J., have been reopened after a closure of a month on account of the machinists' strike. It is stated that 450 of the old employees returned to work, only a dozen names being missing from the roll.

ELECTRIC LIGHTING IN SPAIN.—The municipality of Rieza, Spain, will on July 9 close a concession for the establishment of a municipal electric light plant and operating the same for 20 years, at an upset price for the concession of $579 per annum.

NIAGARA DEVELOPMENT.—At 12.20 p. m., Wednesday, June 26, a great blowing of the whistles of the numerous hoisting engines and locomotives of the National Construction Company, having in charge the sinking of the wheel-pit of the Niagara Falls Power Company, announced, with all the clamor at their command, that the depth of 180 ft. below the surface had been reached, opening into the tunnel recently finished by A. C. Douglass. This completes the full depth of the northern terminus of the new wheel-pit, and the southern end, having still about 40 ft. to be excavated, will be finished before many months, and the work of excavation ended. The tunnel extension, leading from the new wheel-pit under the intake canal, and connecting with the wheel-pit of the present power-house, is extended 30 ft. or more, and the work of laying brick has been begun. Small dummy cars are being run to and fro, removing the rock as it is blasted from the tunnel. The completion of tunnel, wheel-pit, and power-house extension will bring about a doubling of the present capacity of the Niagara Falls Power Company. The work of placing the penstocks from the forebays to the inside wall of the power-house is progressing rapidly, some being already completed. In a short time the iron work will be begun. Work upon the Norton Emery Wheel plant and the Castner Alkali Works, also the Niagara Electro-Chemical Company is being pushed forward rapidly, and the upper Niagara is a scene of ceaseless activity.

ASSOCIATION FOR PROMOTING COMMERCIAL INSTRUCTION.—Under date of June 6, 1901, the United States State Department has received from the International Association for the Advancement of Commercial Instruction (Leonhardstr. 21, Brunswick) the programme and the order of exercises of the constituent meeting at Zurich, on July 11-13, of this year. The United States is requested to send as representatives members of institutions of commercial instruction. Persons interested in the matters of trade and commercial education are invited to become members of the association. The utility of an international association of this nature will be discussed at the inaugural meeting, to be held at Zurich. The universal nature of trade, it is stated, makes it possible for the question of commercial education to be internationally treated in an advantageous manner, as the bases of trade and mercantile requisites are essentially the same in all countries. It is desirable to have an annual statistical review, published in several languages, as well as a central office, to collect the educational plans of various countries and to give information to those interested.

CLARK AUTOMATIC TELEPHONE SWITCHBOARD COMPANY.—The annual meeting of the stockholders of the company was held June 18, and the management reported affairs in good condition, with inquiries increasing. A complete plant has been installed in South America to be used in connection with the Santa Marta Railway Company. Contracts for plants have been received from the Thomson-Houston Electric Company, of Rugby, England; the Societe Alsacienne de Constructions Mecaniques, Mulhouse (Haute Alsace), Germany, and the Semet-Solvay Company, Ensley, Ala. Immediately following the stockholders' meeting the directors met in a short session and elected the following officers and directors: Hon. E. L. Freeman, president; E. M. Prindle, vice-president; Moses E. Torrey, treasurer; F. A. Seib, secretary; John L. Putnam, acting general manager; Albert E. Farwell, Alfred S. Clark, Julius H. Preston, Jeremiah W. Phillips, A. Van Wagenen, George H. Smith, William H. Herrick, directors.

ORDERS FOR ENGLAND.—Edward Bergtheil and H. Wilson Young, of the British electrical engineering and contracting concern of Bergtheil & Young, Camomile Street, London, E. C., who, it will be recalled, were recently on a visit to the United States, are understood to have left behind them some important orders for the specialties of Bullock Electric Company, Eugene Munsell & Co., and the H. W. Johns Manufacturing Company. The latter concern is said to be shipping some substantial quantities of its wire construction material to Europe. Among the many recent important domestic contracts secured by the Johns people is one for about 80 miles of No. 0000 grooved wire construction which will be utilized for high-speed interurban traction work in Pennsylvania.

MADRID TRAMWAY CONCESSION.—Tenders are invited by the Ministry of Agriculture, Industry, Commerce and Public Works at Madrid, for the concession and operation for 60 years for an electric railway from the Santuario de la Yedra to the railway station at Baeza. A provisional deposit of $1,250 will be required to qualify any tender. The contract closes July 26.

FANS, ETC., FOR SPAIN.—The National Association of Manufacturers, Philadelphia, reports that Alvaro Urena, Barquillo 14 y Sauco 1, Madrid, Spain, is inquiring for prices and best discounts on electric fans and ventilators, electric motors, electric bells, storage batteries, etc.

TURBINES FOR BRAZIL.—The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, shipped recently on the order of Rose & Knowles, Sao Paulo, Brazil, one 18-inch improved cylinder gate Victor turbine mounted horizontally in steel penstock with quarter turn discharge. The waterwheel shaft was extended through the neck of the quarter turn and carried by ring oiling swivel bearings supported by heavy cast iron yokes. The shaft is fitted with two cast iron pulleys for belt drive. The wheel will develop 59 effective horse-power under 20 ft. working head, and will be belted to the two small dynamos for furnishing electric light in the cotton mills of Messrs. Jose Weissohn & Co., Salto de Ytie, Brazil.

MONTAUK CHANGES NAME.—The Montauk Multiphase Cable Company will be known hereafter as the Montauk Fire Detecting Wire Company. Mr. John D. Gould, president, says: "This change of name is not on account of reorganization of the company, but has been made for the purpose of more fully conveying to the public the nature of our business. We have received so many communications which indicate that wrong conclusions have been drawn as to the product we manufacture, that it was deemed advisable by the stockholders at their annual meeting May 1, 1901, to adopt the new corporate name."

POWER IN NORTH CAROLINA.—The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, report that a few days ago they shipped to the North Carolina Electrical Power Company, Marshall, N. C., one of their 27-inch improved cylinder gate Victor turbines on horizontal shaft in a wrought iron flume. The wheel is made entirely of bronze and under 60 ft. working head of water will develop 750 horse-power. The shipment also included 70 ft. of steel feeder pipe, three sets of head gate irons and the necessary water rack. The power of this wheel will be used for driving the plant of one of the street railways of Asheville, N. C.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a contract with the Edison Illuminating Company, of Detroit, Mich., for a doubling of the capacity of their present installation of Chloride accumulators. The original installation consisted of 160 elements, and the tanks were constructed to allow the present increase, making a total normal discharge rate of 20,480 ampere-hours. Mr. Alex Dow, manager of the Edison Company, has had this enlargement under consideration for some time past.

ELECTRIC FANS IN INDIA.—According to French official reports which have reached the United States State Department through Consul-General Guenther, the demand for electric ventilators in British India exceeds the supply. American manufacturers are handicapped somewhat by the fact that the people of British India prefer fans with blades from 4½ to 6 inches long, while those of American make are only about 3 inches long. The establishment of a depot for automobiles in Bombay is also spoken of as of great promise for business.

THE RUSSIAN-AMERICAN EXPORT & IMPORT COMPANY, whose New York offices are located at 120 Liberty Street, is about to place some substantial orders for electrical apparatus, supplies, etc. Mr. J. Rich, the general manager of the company, has just returned from a seven months' tour throughout European Russia. He opened a branch establishment in Odessa, where the first permanent exhibition of American machinery in Russia is on view.

THE ELECTRIC EXPRESS SERVICE IN NEW YORK.—Under the arrangement between the Metropolitan Street Railway Company and the New York Electric Vehicle & Transportation Company express cars will be hauled at night over the Columbus Avenue and the Third Avenue lines as soon as some details are arranged. It is not expected that this express service will be extended to the Broadway line, at least for the present.

ARC LAMPS FOR CANADA.—Note was made in these pages last week of the new work of the St. Lawrence Power Company at Sheik's Island, Ont. In addition to the Bullock equipment there noted, it should be added that the General Incandescent Arc Light Company have sold to the Power Company 275 G. I. series alternating arc lamps.

THE J. G. BRILL COMPANY, of Philadelphia, will install its 21E trucks on the electric traction system now under construction at San Sebastian, one of the principal Spanish seaside resorts. The order was secured through Gustav Carde et Filo et Cie, of Paris, which concern is said to have undertaken the contract for the equipment of the major portion of the new road.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has been awarded a fair-sized contract for the electrical equipment of the Spanish Government gun works at Trubia, Spain. Shipment will be made next week of some 30-hp shunt-wound, slow-speed motors and rheostats.

THE H. W. JOHNS MANUFACTURING COMPANY has recently secured the contract for covering the cylinders, pipes and receiver at the Edison Portland Cement Company, Stewartsville, N. J., for the account of Allis Chalmers Company, successors to E. P. Allis & Co., Liberty Street, New York City.

CHINA.—A German firm is announced to have secured a contract for the electric lighting of Pekin. The size of the contract or plant is not given.

General News.

THE TELEPHONE.

PHOENIX, ARIZ.—The International Wireless Telephone & Telegraph Company has been incorporated here, with a capital stock of $25,000,000. The papers are from Philadelphia and are signed by W. Gehring, H. W. Shoemaker, R. Leander, W. J. Moss and Henry W. Bash.

MEDFORD, ARK.—The Arkansas River Telephone Company, recently incorporated, will build its first line from Dumas to Red Fork, via Pendleton and Medford. Extensions will afterward be carried from Pendleton to Pine Bluff, to get connection with, probably, the Southwestern system. The officers of the company are X. J. Pindall, president; J. Bernhardt, vice-president, and H. P. Buck, secretary.

SAN FRANCISCO, CAL.—Alexander McAdie, chief forecast official of the Weather Bureau in San Francisco, recently received a dispatch from Chief Clerk W. L. Moore, Washington, D. C., stating that the government authorities had decided to establish wireless telegraph stations in San Francisco and other coast points as soon as a suitable system became available.

SAN FRANCISCO, CAL.—M. Adrian King has filed a petition with the board of supervisors asking permission to establish a telephone system here. Fifty free telephones are offered to the city, a fire and police telegraph system at a cost not to exceed $12 for each telephone per year, and the agreement is offered that the company will forfeit all rights if it does not have 5000 subscribers at the end of three years.

DENVER, COL.—The Colorado Fuel & Iron Company will soon be free from alliances with the telegraph companies. Men are in the field now to construct a line over a thousand miles long connecting all branches of the company's service with headquarters in Denver.

PIERRE, S. D.—Articles of incorporation of eight companies, with $5,000,000 capital, have been filed by Philadelphia and Pierre citizens for wireless telephone and telegraph companies.

DOVER, DEL.—A certificate incorporating the Consolidated Telephone Company of Wilmington, Del., capital $10,000,000, has been filed.

WILMINGTON, DEL.—The Delaware & Atlantic Telegraph & Telephone Company has established a large number of pay stations in different parts of Wilmington.

AUGUSTA, GA.—The Mitchell & Grange Telephone Company announces connections with Grange, Ga.; Louisville, Ga.; Swainsboro and other points. The early completion of a telephone line between Gibson and Mitchell is anticipated.

PEORIA, ILL.—The farmers of French Grove are arranging for the construction of a telephone line.

CHAMPAIGN, ILL.—The Western Independent Telephone System has established an exchange in Weston, which connects about forty different houses and farmers in that vicinity.

PEKIN, ILL.—The Secretary of State has licensed the Citizens' Telephone Company of Pekin, Ill. Capital stock, $50,000. Incorporators: Jas. M. James, James W. Barrett and E. R. Periton.

CHICAGO, ILL.—Changes ordered in the outlying service of the Chicago Telephone Company involve a general reduction in rates. A new basis for charges has been established, and the old grounded lines are to be abandoned for the improved express service. Eighty towns surrounding Chicago are affected. This order for improved service was sent out by President Sabin to all the branch offices in the Chicago district and will be in full force July 1. While the reduction in rates is general, it varies. In some instances it amounts to as much as $12 a year. The new rate is based upon the monthly service, for which a charge of from $1 to $4 is made, according to the service and the number of patrons on a wire. All the old telephones are being taken out and replaced with the up-to-date copper metallic instruments.

INDIANAPOLIS, IND.—The Farmers' Mutual Telephone Company has been incorporated. Capital stock, $2,000.

INDIANAPOLIS, IND.—The Board of Works has approved the plan of the New Telephone Company for the new conduits that will be necessary by the erection of the Federal building.

INDIANAPOLIS, IND.—Severe electric storms during the past week seriously impaired the telephone service throughout the State. A number of exchanges were burned out and others were abandoned during the storms.

PERU, IND.—The Peru Home Telephone Company has filed articles of incorporation, with a capital of $30,000. The company proposes to establish an exchange and construct lines throughout the county. The directors are C. J. S. Kumler, J. M. Bergeman and Jerome Herff.

ROSSVILLE, IND.—The citizens of this city and community have arranged for a coöperative telephone system. In addition to a local coöperative system, the service is aimed to cover a radius of eight or ten miles in the country and all to be connected with long-distance 'phones.

INDIANAPOLIS, IND.—The Indiana State Board of Tax Commissioners has been called to sit in annual session. The first session will be devoted to the hearing of statements regarding the property of telegraph and telephone companies and fixing the assessment for taxation.

LOGANSPORT, IND.—There is a movement here to organize a home telephone company to compete with the Central Union, which has announced a graded schedule of rates at a substantial increase, to become effective July 1. Patrons say they will not pay the increased prices, but will order their telephones taken out. The New Telephone Company, of Indianapolis, was asked to come to the relief of Logansport, but it regarded the prevailing rates as too low. The Central Union has solicitors at work seeking subscribers to the party lines and "kitchen" service.

WHITESBURG, KY.—The citizens of this place will subscribe liberally for the building of a telephone line from Stnoega, Va., and work will be commenced on the line at once.

BALTIMORE, MD.—The Northern Neck Telephone Company will extend its lines to the towns of Kinsale and Colonial Beach, and later will establish communication between Litwalton and Warsaw and Warsaw and Village.

SAGINAW, MICH.—The Citizens' Telephone Company now has a pole gang at work from Cedar Rapids running a line east through Evans and Howard, to connect with Greenville and Ionia.

DETROIT, MICH.—The People's Telephone Company has received bids for the foundation of the building to be erected at the corner of Park and Elizabeth Streets, and the contract has been awarded.

DETROIT, MICH.—At a meeting of the stockholders of the Michigan Telephone Company directors were chosen for the ensuing year as follows: Philip Dexter, Reginald Foster and Thomas Sherwin, of Boston; J. W. Lotta, of Philadelphia; Dudley E. Waters, of Grand Rapids; E. A. Forbes, of Detroit; Charles J. Glidden, of Boston, and Hugh McMillan, of Detroit. There was no change in the list of Michigan directors, but a new list of directors was chosen for the Detroit and New State companies.

MINNEAPOLIS, MINN.—The Twin City Telephone Company will spend something like $900,000 this season in extending and improving its systems in the Twin Cities. Of this amount $500,000 will be spent in Minneapolis. The work on the improvements has been going on for some weeks, and it will not be completed until late in the fall.

ST. PAUL, MINN.—The Northwestern Telephone Exchange Company reports a net gain of 135 subscribers in May, making a total number of 22,647 subscribers on May 31. The Erie Telephone System, of which this company is a part, reports a net gain of 3564 subscribers in May, and a net gain of 8545 since Jan. 1, making a total number of 150,144 subscribers on May 31.

MACON, MO.—Statement of increase of capital stock from $10,000 to $15,000 has been filed by the Macon Telephone Company, at Jefferson City.

JEFFERSON CITY, MO.—The Congree-Regal Telephone Company, with a capital of $1,175, has filed letters of incorporation. The incorporators are H. O. Alspaugh, J. W. Rice, C. A. Kavanaugh and others.

CRAIG, MO.—The Craig Telephone Company, which was recently organized with a capital of $1,500, contemplates some country line extensions. The company has just commenced business and uses Stromberg-Carlson apparatus.

MONROE CITY, MO.—W. H. Elliott, H. W. Wood, Frank Orr, A. C. Floyd, Lee Edy, Mark Hawkins, Samuel Wilson, James Settle and Edward Stewart, proprietors of the Hereford and Halch Telephone companies of Ralls County, met June 22 at Monroe City and consolidated on the reciprocity plan, giving them connection with all lines in Ralls, Marion, Monroe and Shelby counties.

WEST POINT, NEB.—The Nebraska Telephone Company is spending $5,000 in improving its local plant. Wires are being strung in metal tubes instead of singly, a new and improved switchboard is being put in and other improvements are under way.

ALBANY, N. Y.—The Richfield Springs Telephone Company, of Richfield Springs, has been incorporated with a capital of $5,000.

UTICA, N. Y.—The stockholders of the Interstate Telephone Company have voted to increase the capital stock of the company from $50,000 to $75,000. The additional stock will be used to equip the exchanges in St. Johnsville, Fort Plain and Canajoharie.

ALBANY, N. Y.—The State Board of Tax Commissioners has placed valuations on telephone franchises as follows: Troy Telephone Company, $45,000; Central New York Telegraph Company, Syracuse, $191,000; Central New York Telegraph Company, Utica, $73,000.

ALBANY, N. Y.—The Valley Telephone Company has been formed, capital $75,000, to operate a telephone system in Waverly, Tioga county, N. Y., and Sayre and Athens, Bradford county, Pa. Directors: Joel H. Fuller, Kerm F. Gill, Charles B. Stowe and Burt G. Hubbell, of Cleveland, O.; Frank Pike, of Sayre, Pa.; Fred E. Lyford, of Waverly, N. Y., and Vine Crandall, of Athens, Pa.

BUFFALO, N. Y.—A committee of the Central Council of the Business Men's Associations discussed the question of forming a municipal telephone company, with a capital of $1,000,000. Those present were: Chairman J. N. Adam, A. J. Elias, L. D. Wood, R. A. Eaton, James Fenton and Albert H. Jackson, of the corporation counsel's office. The company is to be formed to pave the road to municipal ownership, in the meantime giving cheap telephone service. The plan was referred to a sub-committee.

ALBANY, N. Y.—The Interocean Telephone & Telegraph Company has been incorporated with a capital stock of $2,000,000. The company will operate a telephone and telegraph system, connecting the following places: Cleveland, Ohio; Westfield, Buffalo, Niagara Falls, Rochester, Oswego, Ogdensburg, Whitehall, Syracuse, Rome, Utica, Schenectady, Troy, Albany, Poughkeepsie, New York City, Newburgh, Goshen, Binghamton, Cortland, Owego, Waverly, Elmira, Ithaca, Auburn, Canandaigua, Corning, Hornellsville, Genesee, Jamestown, Salamanca and other cities and villages in New York State and Jersey City, N. J. The directors are Charles H. Stewart, Joel H. H. Fuller, Chas. B. Stowe and Burt G. Hubbell, of Cleveland, O.; William T. Morris, of Penn Yan, and Harry K. Brown, of Hornellsville.

LOGAN, OHIO.—The United States Telephone Company is building a new line from this place to Nelsonville, connecting several small exchanges in Athens county.

WARREN, OHIO.—The operators of the Central Union Telephone Company at this point are on strike. Their places have been filled by girls from Ashtabula and Girard.

WASHINGTON, C. H., OHIO.—The Citizens' Telephone Company, of this place, has increased its capital stock from $50,000 to $100,000 to provide for improvements. Jerome Penn is manager.

NEWARK, OHIO.—Hon. Edward Kibler, president of the Newark Home Telephone Company, has obtained a franchise for an independent exchange at Utica, N. Y., and has made application for a franchise in Pataskala, N. Y.

PLEASANTVILLE, OHIO.—The local authorities have brought suit against the Central Union Telephone Company to restrain it from building telephone lines through this place and to oblige it to remove those in operation. It is claimed the company never secured a franchise.

CIRCLEVILLE, OHIO.—The Citizens' Telephone Company is making rapid progress in the construction of its local exchange and it is expected that it will be in operation within a short time. Branch exchanges are being built at Williamsport and Asheville and others will be built in this county as soon as franchises are secured.

MANSFIELD, OHIO.—The linemen employed by the Central Union Telephone Company at this point are on strike. The company has acceded to their demands for $2.50 per day for city work and $40 per month and expenses for country work, but it has declined to discharge several non-union men, which are objectionable to the union men.

MARION, OHIO.—The recently organized Marion County Telephone Company has perfected its organization by electing the following officers: President, Fred E. Gunthery; Vice-President, C. H. Norris; Treasurer, O. Wollenweber; Secretary, French Crow. A franchise application is now pending, and if granted, a system will be installed in this place and throughout the county.

CLEVELAND, O.—Papers have been forwarded to Dover, Del., for the incorporation of a $12,000,000 company to be known as the Consolidated Telephone & Telegraph Company. This company will father a number of independent companies between Boston and Chicago, and will reach the more important cities between those two points.

WHITNEY, ORE.—The Blue Mountain Telephone Company, of Whitney, was recently incorporated. Directors: Burton Miller, J. M. Jones and Austin Craig. Capital stock, $5,000.

PHILADELPHIA, PA.—The Pensauken township committee passed ordinances granting franchises to the Eastern Telephone & South Jersey Gas, Electric & Traction Companies.

ERIE, PA.—The Mutual Telephone, at its annual meeting, elected these directors: W. B. Trask, Wm. Spencer, W. E. Hayes, Thos. E. Moore, T. A. Lamb. The directors chose these officers: President, W. B. Trask; Secretary and Treasurer, George Burton. The company now has in actual use 1,300 telephones. There has always been a steady increase in the number.

PITTSBURG, PA.—The Federal Telephone Company of Pennsylvania and the West Penn Telephone Company of Washington, Pa., are contending in the courts of Washington County for the right to construct a telephone line in the town of Washington. It appears that councils of that place granted telephone franchises in 1894 and 1896 to the Washington Telephone Company and the Washington County Telephone Company, but neither made any effort to construct a line or erect a plant until after the organization of the West Penn Telephone Company, an independent concern. Then the Federal people came in and began to dig holes and put up a line, claiming to have purchased the franchises of the Washington Telephone Company and the Washington County Telephone Company. In the meantime councils have repealed the ordinances of 1894 and 1896, and now the Federal Company is contending for its rights to construct its lines.

PITTSBURG, PA.—Director E. M. Bigelow, of the Department of Public Works, of this city, has renewed the contract with the Central District & Printing Telegraph Company for telephone service in the City Hall and the Department of Public Works. Former Director George W. Wilson made a contract with the Pittsburg & Allegheny Telephone Company, the competitor of the Bell Company, but, although the service has been installed, the contract was never approved by city councils. There has been a fight on for some time on account of the agreement in the franchise granted the Pittsburg & Allegheny Company, under which the company was to furnish free telephones to the city government officers. Then an ordinance was presented limiting the number of free telephones to eighteen. Neither this ordinance nor Director Wilson's contract has been approved by councils. Now, if the contract with the Central District & Printing is renewed and the Pittsburg & Allegheny Company is held to the agreement contained in its franchise, then the city will have the use of both telephones at the cost originally paid to the Central District & Printing Company.

MEMPHIS, Tenn.—The report that the Memphis Telephone Company would sell to the Cumberland Telephone Company, which has been current for some time, has been emphatically denied by General Manager Warren, of the former company.

MILAN, TENN.—Crews are now at work putting in a telephone line from Milan to Lavinia, ten miles east of here, in Carroll county. This will be under the control of the local exchange of the Cumberland Company and will prove a valuable adjunct to the local service, as the line penetrates a fine section of farming country. The line will probably be completed in thirty days.

AUSTIN, TEX.—Work has begun on the new telephone system. Poles are being erected, property purchased and other arrangements made for the installation of an independent company. This will give Austin two telephone exchanges.

AUSTIN, TEX.—The Brazoria County Telephone Company, of Columbia, has been incorporated, capital stock, $10,000, to operate a telephone line from Columbia to Rosenberg and Richmond, connecting with Angleton, Alvin, Houston, Brazoria, Velasco, Quintana, Van Vleck and Bay City. Incorporators: L. L. Smith, Jr., R. B. Loggins and J. E. Duff.

SALT LAKE CITY, UTAH.—Another application for a telephone franchise will probably be presented to the city council in the near future. It is understood that W. G. Van Horne is the local representative of Eastern capitalists, who are ready to establish a competing system in Salt Lake provided the right sort of a franchise can be secured.

PARKERSBURG, W. VA.—A movement has been started and a meeting of the interested parties already held to merge all the independent telephone lines in West Virginia into one company. It is estimated that the value of the property under the consolidation will reach $1,000,000. The new company will be capitalized for several times that amount. A committee has been appointed to inspect and report upon the various properties and the big scheme will likely be perfected within a few weeks.

CHIPPEWA FALLS, WIS.—The Chippewa County Telephone Company has just finished an extension to Bloomer and now has men working on an extension to Chippewa Falls. It uses the apparatus of the Standard Telephone & Electric Company, of Madison.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CAL.—The Salem Light, Power and Traction Company has been incorporated, with Salem, Ore., as the principal place of business. Directors: W. H. McRae, F. H. Page and Rufus Mallory. Capital stock, $130,000.

OAKLAND, CAL.—The Suburban Electric Light Company, of Oakland, was recently incorporated. Directors: J. H. Lawrence, Wm. Angus, W. Gregg, Sr., J. L. Robinson, Alameda County; E. P. O'Brien, San Francisco. Capital stock, $500,000.

COLORADO SPRINGS, COLO.—The management of the Colorado Electric Company is now considering the extension of its lines from Canon City to Florence, a distance of eight miles, where electric power is in good demand.

TELL CITY, IND.—The Tell City Electric Light Company has been incorporated with a capital of $40,000.

INDIANAPOLIS, IND.—Mayor Taggart has vetoed the ordinance prohibiting electric arc lights on interurban cars in the city.

TIPTON, IND.—The Tipton Electric Light Company has been incorporated with a capital of $25,000, for the purpose of providing the town and citizens of Tipton with electric light and power. C. W. Ramsey heads the list of directors.

PORTLAND, IND.—Municipal electric lighting has proven a success in this city in point of good service and economy. The report for the first year ending June 1 shows a good balance after all expenses were paid. Portland used to pay $85 a year for each street light, but they cost, under municipal control, only $23.40.

INDIANAPOLIS, IND.—The General Electric Company has filed articles with the Secretary of State in compliance with the new foreign incorporation law of Indiana. The capital represented in Indiana is in the Fort Wayne Electric Works, and Secretary F. E. Hunting is named as the company's resident agent.

INDIANAPOLIS, IND.—The specifications for the new electric light contract for this city are still being much discussed, and some of the questions asked are still without answers, inasmuch as the Indianapolis Light & Power Company claims to have a perpetual franchise to furnish private lighting in this city. There is a good prospect of litigation, as outside companies desire the question settled before they bid on the specifications for public lighting. It is rumored that a movement is on foot to establish an electric lighting plant to be controlled by the municipality.

WORCESTER, MASS.—The directors of the Worcester Electric Light Company have voted to give the city an extension of ninety days on the contract for lighting streets, which expires July 1.

MACON, MO.—At the meeting of the city council bids were opened for the erection of the new power house for the city's electric light plant. The council awarded the contract to John Scott & Son, of Lancaster.

CAPE MAY, N. J.—Mayor Millet has approved the ordinance granting to the Cape May Electric Company the contract to light Cape May with arc lights for five years at the price of thirty-five cents per light per night. Supreme Court Justice Charles E. Hendrickson has granted a rule to show cause why the ordinance should not be set aside as irregular.

CHATHAM, N. Y.—It is stated that William Sheehan & Co., of New York City, are completing plans for a new municipal electric light plant, to be erected by Chatham, N. J.

SYRACUSE, N. Y.—Justice Andrews has denied the motion for the receiver of the Dolgeville Electric Light & Power Company to borrow money for the erection of a line to supply the city of Little Falls with electric light.

BUFFALO, N. Y.—Electricity is to take the place of steam as the motive power in the New York Central's Niagara B elevator. New Scotch boilers are being placed in the Buffalo dry dock yards to take the place of the four present boiler plants.

ALBANY, N. Y.—The State Board of Tax Commissioners has placed valuations on franchises as follows: Auburn Electric Light Company, $115,200; Watertown Electric Light Company, Watertown, $22,000; Electric Light Company, Syracuse, N. Y., $298,000.

FREEPORT, L. I.—The village trustees have been forced to go back to the old rates for electric lights and the rates for short term electric light consumers furnishing their own transformers has been reduced to twelve cents per kw-hour. Where the village furnishes the transformers, the rate for a term of six months is twenty cents.

SPRINGFIELD, O.—A new line, to cut across the country, connecting this city with Charleston, Vienna and other inland towns, is being agitated.

ALLIANCE, OHIO.—The Stark County Railway Company has purchased a site near this place for a power house for the new Alliance-Sebring line.

MARYSVILLE, OHIO.—The council has granted a franchise through this place to the Union Electric Railway, which is promoted by T. N. Kerr, of Columbus.

DAYTON, OHIO.—A petition for the dissolution of the Oakwood Street Railway Company, which operates eight miles of road in this city, has been made by the Atlas P. Stout.

COLUMBUS, O.—The Wellsville Electric Light Company, East Liverpool, has increased its capital stock from $30,000 to $100,000.

SEBRING, OHIO.—The City Light & Power Company has been incorporated, with $25,000 capital stock, to build a lighting plant.

MARION, OHIO.—The plant of the Marion Electric Light & Power Company was damaged by fire to the extent of $2,000 a few days ago.

CLEVELAND, OHIO.—Several members of the city council have declared war on the Cleveland Electric Illuminating Company and propose, if possible, to force it to arrange an equitable scale of prices.

NORTH AMHERST, OHIO.—The city has had estimates prepared for a municipal lighting plant, and it is figured that a plant with a capacity of 50 arc lamps and 500 incandescents would cost about $8,000.

NILES, OHIO.—The Wiswell-Pritchard Electric Manufacturing Company, recently incorporated, has changed its name to the Standard Electric Company. The company will manufacture incandescent lamps and other goods.

CINCINNATI, O.—The Taxpayers' Association, of this city, has addressed a communication to the Board of Public Service, asking that estimates be made of the cost of the electric lighting, per lamp, and that these estimates be taken as a basis, and all bids not coming within the figures to be rejected. This is in anticipation of the renewal of the city lighting contract.

CINCINNATI, O.—D. J. Hauss, of this city, has acqired the plants of the Georgetown (Ky.) Water Company and the Georgetown Electric Light Company. An old contract with the city of Georgetown gives Mr. Hauss the exclusive right to sell electric light and power for twenty years. Improvements to the amount of $30,000 are contemplated, about $20,000 of this is to be expended for electric light equipment.

CLEVELAND, OHIO.—The Cuyahoga County Commissioners have awarded a contract for a lighting plant for the county buildings to C. C. Bateson, his figure being $9,960. The plant is to be modern in every respect, with capacity for 3000 lights. Wiring for 2500 lights will be put in at once. The commissioners figure on saving the cost of the plant in one year, the price paid for lighting during the past year being $8,000. The plant will be so constructed that it can be removed to the proposed new courthouse with very little expense.

COLUMBUS, OHIO.—The officials of the Columbus Electric Company have made a proposition to the city to lease its west side lighting plant to the municipality for one year at $15,000, or, if the city will pay the taxes, for $13,500. This will be subject to renewal for three years. The plant has a capacity for 1,250 lights and the lighting committee has figured that it will cost about $30,000 to operate the plant. On this basis lamps would cost about $36 per year each. It is quite probable that the proposition will be accepted, as the municipal lighting plant cannot be erected by Sept. 1, when the present lighting contract expires.

BLAIR STATION, PA.—The St. Clair Furnace Company is building three large new blast furnaces, for which the Westinghouse Electric Manufacturing Company will supply the generating plant for light and power.

AMBLER, PA.—The borough council of this place has awarded the contract for lighting the streets to the Montgomery Lighting Company, which will be chartered for that purpose. The contract calls for 100 twenty-five candlepower incandescent lamps, at $20 each, for a period of five years.

ALTOONA, PA.—The Altoona Edison Electric Light Company is strengthening its line in various parts of the city by putting in new and heavier poles in the place of those which have passed their period of usefulness.

CHATTANOOGA, TENN.—The county has finished the installation of its electric lighting plant for the public building and county bridge.

SALT LAKE CITY, UTAH.—The mines and mills of Park Valley are to be provided with electrical energy. The Golden Electrical Power & Transmission Company has been organized with a capital of $50,000 by business men of this city, with a view to supplying the power and light used in that camp. The company will utilize the waters of George Creek at a point about four miles from Park Valley, and expects to be able to turn on the electric current within the next six months. Contracts for furnishing power have already been made with the Century, the Planetary, El Amigo, West Century and Golconda mining companies.

RICHMOND, VA.—J. F. Wilson has the contract for erecting the power house at Richmond Locomotive Works. The building is to cost $4,000.

THE ELECTRIC RAILWAY.

HARTFORD, CONN.—It is expected that the through trolley line from Hartford to Springfield will be operation by Sept. 1.

DES MOINES, IOWA.—The Des Moines, Nevada & Eldora Electric Railway Company has been incorporated, with a capital stock of $50,000.

CHICAGO, ILL.—Suit has been brought against the city of Chicago by Union Traction people to prevent the city from interfering with the roads and to declare the franchise good till 1960. This is a test of the ninety-nine-year franchise act.

HARTFORD CITY, IND.—The city council has voted the Ft. Wayne, Hartford City & Muncie Electric Railway Company a new franchise.

PLAINFIELD, IND.—Articles of incorporation of the Indianapolis, Plainfield & Western Traction Company have been filed. The capital of the company is fixed at $200,000.

MARION, IND.—The Richmond Traction Company has purchased the abandoned power plant of the Union Traction Company; in this city, and will remove it to Richmond, to be used in operating the Richmond line.

GOSHEN, IND.—A $20,000 subsidy was voted to the Goshen & Northern Indiana Traction Company for an electric line from here to Angolia. The majority was large in favor of the proposition and work will begin at once.

ANDERSON, IND.—George F. McCulloch, president and general manager of the Union Traction Company, is in Philadelphia in conference with Randall Morgan and other large stockholders of the company. It is the belief that the conference will result in a deal in which the Union Traction Company, recently incorporated under the laws of New Jersey for $15,000,000, will secure control of 160 miles of electric railway system centering in Anderson.

INDIANAPOLIS, IND.—Roughly estimated plans have been drawn for nearly a thousand miles of electric roads in this State. The last legislature gave the interurban road promoters a great lift by enacting a law giving them the same right of eminent domain that is enjoyed by steam roads. Thus, they are going right on surveying and condemning rights of way they could not have obtained without the law. The question whether an electric line company can condemn a right of way alongside of a steam road, taking a portion of the fifty feet allowed steam roads by law, is now in the court, and the electric promoters confidently expect a decision in their favor.

BALTIMORE, MD.—The Frostburg, Eckhart & Cumberland Electric Railway and the Lonaconing, Midland & Frostburg Railway Companies have purchased a lot of ground near Clarysville and will erect the power house for the new electric car line from Cumberland to Lonaconing.

BOSTON, MASS.—The railroad commissioners have issued an order on the petition of the Worcester Consolidated Street Railway Company for authority to issue additional capital stock to the amount of $1,675,000.

OWOSSO, MICH.—Work has finally begun on the extension of the Owosso & Corunna Electric Road.

MICHIGAN.—The Everett-Moore syndicate is negotiating for the purchase of another large system of interurban trolley line, which, when added to their thousand miles of traction, will give them a line from Port Huron, Mich., to Pittsburg, Pa. Three States will be crossed.

MINNEAPOLIS, MINN.—The Minneapolis & Anoka Railway Company has been incorporated by John J. Elliott, Arthur W. Selover, E. E. Fuller, George H. Selover and William Williamson, all of Minneapolis. The capital stock is fixed at $200,000.

ST. PAUL, MINN.—There is good reason to believe that Canadians have secured control of the Rapid Transit lines. A new electric line is to be built, connecting Minneapolis with Anoka, about 25 miles. A company has been formed for this purpose and it is believed that the line will also be extended to St. Paul. On the Twin City Rapid Transit line, which has two tracks between St. Paul and Minneapolis, traffic is often greater than the accommodations, and the advent of a new line will be welcomed. The recent heavy purchases of Twin City Rapid Transit stock by Canadians and the presence of Canadian capitalists has given rise to the rumor that the new line will be built by the latter, though the incorporators are local business men.

UTICA, N. Y.—An electric railroad, connecting the village of Clinton, is to be built this season, giving a direct line from Clinton to Utica.

CANANDAIGUA, N. Y.—The board of trustees granted a franchise to the Ontario & Wayne Traction Company, giving it the privilege of building its tracks through the village.

AMSTERDAM, N. Y.—The Amsterdam Street Railroad Company and the Schenectady Railway Company have reached an amicable adjustment regarding their differences over the proposed railway from this city to Schenectady.

ALBANY, N. Y.—A lease of the Brooklyn Union Elevated Railroad Company to the Brooklyn Heights Railroad Company, of Brooklyn, has been filed with the Secretary of State. The lease is of the date of July 1, 1901, and expires June 30, 2900.

NEW YORK, N. Y.—The War Department has granted the request of the Rapid Transit Commissioners for permission to make borings and surveys along the bed of the East River along the route of the Brooklyn tunnel, and the contract will be let in a few days.

ALBANY, N. Y.—The Canastota & Morrisville Railway Company, organized with a capital of $200,000 to operate a street surface electric road from Canastota to Morrisville, Madison county, has been incorporated. The directors are: Leander W. Burroughs, John Reidy, John A. Johnson, John H. Broad and Brownell Tompkins, of Morrisville; William H. Patten, Milton Delano and John B. Weaver, of Canastota; W. Emmett Coe, of Petersboro.

NEW YORK CITY.—The New York & Richmond Gas Company has been incorporated to manufacture and sell gas and electricity for heating and lighting purposes. Capital, $1,500,000 in shares of $100. Directors, Armitage Mathews, Robert C. McCormick, of New York; Archibald A. McGlashan, of East Bloomfield, N. Y.; George W. Sutton, of New Rochelle; H. A. Tucker, of Brooklyn.

ALBANY, N. Y.—The State Board of Tax Commissioners has placed valuations upon street railway properties as follows: United Traction Company, Cohoes, $69,500; United Traction Company, Watervliet, $71,000; Albany & Hudson Railway & Power Company, Hudson, $60,000; United Traction Company, Troy, $513,000; Troy Union Railway, $60,000; Auburn City Railway, Auburn, N. Y., $124,500; Black River Traction Company, Watertown, $28,000; Rapid Transit Railway, Syracuse, $1,200,000; Utica Belt Line, $98,000.

ROCHESTER, N. Y.—At the annual meeting of the Rochester Electric Railway Company the following officers were re-elected: President, T. J. Nicholl; treasurer, F. P. Allen; Secretary, Charles F. Pond. The directors are: T. J. Nicholl, G. G. Moorehouse, S. Stace, W. C. Barry, C. C. Woodworth, Charles S. Baker, H. P. Brewster, George W. Archer, J. Gerling, J. N. Beckley, E. H. Satterlee, Frederick Cook and C. F. Pond. It is stated that an effort is making by the new management of the Rochester Railway Company to acquire the Rochester & Charlotte Railway, which it now operates under a fifty-year lease.

NEW YORK CITY.—The underground system installed by Metropolitan on the Broadway, Lexington Avenue and Columbus Avenue lines is working

very satisfactorily and the outlook is for a largely increased volume of business and considerably decreased operating expense. The present volume of earnings all over the system is enormous. The great trouble now is to handle available business with the present facilities, which are quite inadequate. The new electric line soon to be installed on Seventh Avenue will, however, go far to relieve the strain in the belt of heaviest traffic, but business has developed so that there is no longer a possibility of accommodating all on the surface.

TROY, O.—A branch of the Dayton & Troy Traction Company will be built from Pleasant Hill to this city.

CLEVELAND, O.—The Cleveland City Railway Company's directors have voted a quarterly dividend of 1¼ per cent., payable July 5.

MASSILLON, O.—The Canton-Massillon Railway Company has applied for a franchise to extend the line from Massillon to Navarre.

MT. STERLING, OHIO.—A citizens' committee has petitioned the officials of the Columbus, Grove City & Southwestern Railway to extend its line as soon as possible to Mt. Sterling.

MARION, OHIO.—The Marion County Commissioners have granted a twenty-five-year franchise through the county to the Columbus, Delaware & Northern Traction Company.

STEUBENVILLE, OHIO.—The Steubenville & Wheeling Railway Company, which is promoted by T. K. Francis and W. B. Stringer, has applied to the county commissioners for a franchise.

DAYTON, O.—The strike of the employees of the People's Street Railway Company, declared June 21, was settled in less than an hour. Substitutes were secured and the cars were running as usual within that time.

GALION, OHIO.—The city council has granted a twenty-five-year franchise through the town to the Mansfield, Crestline & Galion Railway Company. This road is promoted by the Pomeroy-Mandelbaum syndicate, of Cleveland.

MANSFIELD, O.—The Mansfield, Cardington & Delaware Electric Railroad Company has organized as follows: President, A. A. Whitney; vice-president, R. F. Chase; C. W. Schaff, secretary, and W. A. James, treasurer.

CINCINNATI, O.—The directors of the Cincinnati, Newport & Covington Street Railway Company have rejected the proposition of the Cincinnati Traction Company for a lease of their property. They did not see a profit in a guarantee of a 5 per cent dividend in eight years.

TOLEDO, O.—The Toledo & Indiana Railway Company has been incorporated by Chas. P. Griffin, O. K. Detwiler, L. W. Brown, Q. J. Files, C. H. Masters, James Donnelly, John Rorick, L. E. Flory, John J. Banker, George G. Metzger and William P. Delaney. Capital stock, $1,000,000.

DAYTON, OHIO.—Judge Dennis Dwyer and Albert Emanuel, who were the original promoters of the Dayton & Stillwater Valley Traction Company, have transferred their holdings to the Robertson Company, of Boston, who have recently secured control of the Dayton & Xenia Traction Company.

CLEVELAND, O.—Senator Martin Dodge, promoter of the Cleveland & Warren Railway Company, has applied to the Cuyahoga county commissioners for a franchise from Newburg to Randall and Chagrin Falls. The road will extend to Warren by the way of Aurora, Mantuax and Garrettsville.

CLEVELAND, O.—The Cleveland, Pittsburg & Detroit Traction Company will be the name of the corporation that will own the trolley lines that will extend from Pittsburg to Detroit by way of this city, and which will have feeders touching every city of any size in Northern Ohio and lower Michigan.

NAPOLEON, OHIO.—A company is soon to be incorporated to build an electric railway from Woodville to Napoleon. Those interested are Capt. L. Black, Dr. J. H. Whitehead, D. B. Whipple, Dr. W. M. Tuller, Dr. F. W. Rogers, R. A. Beatty, A. E. Royce, F. W. Dunn, F. M. Young, Wesley Powell, G. W. Loomis, M. L. Case and A. Forney, all of Bowling Green.

TIFFIN, OHIO.—The Tiffin & Port Clinton Railway Company, of Fremont, has been incorporated by William H. Dore, H. C. DeRan, R. G. Kerlin, E. P. Simon and J. C. Brewer. Temporary capital stock, $20,000. This company, which heretofore has been known as the Kerlin Brothers Company, has secured right of way and done considerable grading on a road from Tiffin to Port Clinton, passing through Fremont.

CLEVELAND, OHIO.—Senator Martin Dodge, promoter of the Cleveland & Warren Railway Company, has filed the consents of property owners for the route of the line through Cuyahoga county. The road will enter Cleveland on the Miles Avenue line and will extend through Corlett, Solon, Geauga Lake, Centerville, Auburn, Mantua, Hiram, Parkham to Warren. It is also the intention to extend north from Warren to Jefferson. The road will open up a rich farming district.

TOLEDO, OHIO.—The Toledo & Indiana Railway Company, which was recently incorporated, has effected its organization by electing the following directors: C. P. Griffin, A. K. Detwiler, L. W. Brown, C. H. Masters, Frank Yesberea, Dr. James Donnelly, Wm. P. Delaney, J. Q. Files, L. E. Florey and George G. Metzger. Officers: C. P. Griffin, president; L. W. Brown, secretary; George G. Metzger, vice-president, and C. H. Masters, consul. C. P. Griffin, A. K. Detweiler, L. W. Brown, W. P. Delaney and E. B. Smith constitute the executive committee.

YOUNGSTOWN, OHIO.—The Sharon & New Castle Railway Company has organized with the following officers: President, W. W. Whipple, of New York; Secretary, M. A. Norris, of Youngstown; Treasurer, O. W. Bright, of New York; Directors, the above, with Harry G. Hamilton, Richard Montgomery and S. D. L. Jackson. The Pennsylvania end of the company was organized shortly after at Pittsburg. Bonds to the amount of $500,000 will be sold at once. Park & Hamilton, of Youngstown, are the contractors and they are preparing to commence work at once.

CLEVELAND, OHIO.—The Everett-Moore syndicate, which is building a line from Akron to Canton and Massillon, has decided to haul coal on night runs to supply the various power houses of the systems owned by the syndicate. The various companies controlled by the syndicate operate about a dozen power houses within a radius of fifty miles of Cleveland, and by securing the output of a mine in the Massillon coal fields, a great saving could be effected. The recent decision of the Ohio Supreme Court whereby freight may be hauled through cities on electric lines, makes this possible.

COLUMBUS, O.—Members of the State Board of Public Works and the Canal Commission are considering the advisability of granting leases to traction companies for rights-of-way on canal property. The Scioto Valley Traction Company, of Columbus, and the Columbus, Winchester & Lancaster Traction Company have both filed applications for lease of right-of-way for several miles along the banks of the Ohio Canal between Groveport and Carroll. The Ft. Wayne, Dayton & Cincinnati Traction Company desires to build along the banks of the Mercer Co. reservoir near Salina. Numerous other applications are on file.

KINGSTON, ONT.—The Electric Street Railway Company has refused the demand of its employees, who are members of a union, for an increase in their wages. The company claims that the road is not a paying concern, and if the men go on strike the company will try to replace them with other men, and failing that, will run its cars into the barn and sell them and the whole plant by public auction.

GREENSBURG, PA.—This town is to have a third street railway, the application of the Coke Belt Railway Company for a franchise having been favored by the borough council. The franchise will be granted.

PHILADELPHIA, PA., has had a big town meeting against the recent free street railway franchises, rushed through the legislature, and for which Mr. Wanamaker's offer to the city of $2,500,000 was refused by the mayor.

PHILADELPHIA, PA.—A. L. Johnson's Philadelphia & Lehigh Valley Traction Company has filed a $2,500,000 mortgage to cover 55 miles of roadway to be built from Chestnut Hill through a number of towns in Philadelphia suburbs.

PHILADELPHIA, PA.—The Commissioners of Northampton County have granted permission to the Doylestown & Easton Street Railway Company to build a trolley line along the Delaware River Road between Easton and the Bucks county line.

PITTSTON, PA.—The new trolley line between Wilkesbarre and Hazleton is now an assured fact. The stock has all been subscribed for and the building of the road will be rapidly pushed. A feature of this road will be the driving of a tunnel half a mile long through the Wilkesbarre Mountains.

HARRISBURG, PA.—The West Fairview & Marysville Street Railway Company, capitalized at $30,000, has been chartered. A charter was also issued to the Altoona Belt Line Street Railway Company, with a capital of $50,000. Charles D. Baltzell, of Altoona, is president of the company.

HARRISBURG, PA.—A charter has been granted to the Bristol Street Railway Company. The concern is capitalized at $36,000 and will build a line from Bristol to Morrisville. The incorporators are G. M. Dorrance, Frank G. Edwards, Frank F. Bell, James Drury and Benjamin Johnson, of Bristol.

HARRISBURG, PA.—Four charters have been granted for surface street railway companies in Pittsburg. The incorporators include George T. Oliver, Thomas J. Crump, F. L. Roberts, John Jenkins and John Barr. The companies and the proposed routes follow: The South Atlantic Street Railway Company, two miles, capital $12,000; the Smithfield & Seventh Avenue Street Railway Company, one and one-quarter miles, capital $15,000; the Grant & Webster Street Railway Company, one and one-quarter miles, capital $15,000; the Reed Street Railway Company, one and one-quarter miles, capital $15,000.

DOYLESTOWN, PA.—William C. Ryan, representing the Doylestown & New Hope Street Railway Company, which proposes to construct a line from New Hope to this place, has filed plans for an extension of the route. The road will pass Mechanicsville through the Cuttalosa to Center Hill and thence to New Hope. The directors of the new company are A. Worthington Rich, C. S. Balderston, Albert Preston, William Watson, Florence A. Rich, William C. Ryan, Frank J. Rich and Burroughs Michener, all of this county. Burroughs Michener is president, William C. Ryan, secretary and C. S. Balderston, treasurer.

KNOXVILLE, TENN.—It is stated that an electric railway will be built by eastern capital from Johnson City to Jonesboro, a distance of seven miles.

BLUEFIELDS, W. VA.—Several miles of the Kanawha Traction Company's track were swept away by the recent disastrous flood in this region.

MANITOWOC, WIS.—The Manitowoc & Northern Traction Company has been incorporated, with a capital stock of $100,000. Thomas Higgins, of Neenah; H. C. Higgins, of Marinette, and State Senator H. I. Weed, of Oshkosh, are the incorporators.

NEW INDUSTRIAL COMPANIES.

THE ELECTRICAL SUPPLY COMPANY, of Cleveland, capitalized at $500, has been incorporated by P. H. Walker, J. H. Hardwick, J. H. Smith, J. E. Mayfield and F. J. Harle.

THE NATIONAL INDICATOR COMPANY has been formed at Ottawa, Ohio, to manufacture a station or street indicator for steam or electric roads, the invention of Mayor Poe, of that town.

THE NEW YORK ESTIMATING, ENGINEERING AND CONTRACTING COMPANY, of New York, has been incorporated to do a general business in the lines indicated in the title. Capital, $10,000.

THE AMERICAN MOTIVE POWER COMPANY has been incorporated at Pierre, S. D., with a capital of $15,000,000. The incorporators are John Martyn Scobec, Lucius C. Varney and Oscar Nelson.

AUGUSTA, ME.—The Fairfield Electric Gas Machine Company has been organized at Kittery with a capital stock of $30,000. The president is William H. Mitchell, of Melrose, Mass., and the treasurer Horace Mitchell, of Kittery.

AMERICAN TYPEWRITER TELEGRAPH COMPANY, of Jersey City, has been incorporated to manufacture electrical devices; capital, $100,000. Incorporators: Spencer W. Richardson, Wm. A. Hill, Richard P. Elliott, K. K. McLaren.

THE UNITED RAILWAY LIGHT AND CHARTER COMPANY, with a capitalization of $5,000,000, was incorporated at Dover, Del. The company is authorized to purchase and acquire land and buildings for operating railways and heat, light and power plants.

LEGAL.

NEW YORK ELECTRIC VEHICLE TRANSPORTATION COMPANY has won the suit brought against it to stop an assessment of $10 on its stock. President Sanderson made a very good showing to Vice-Chancellor Pitney, of New Jersey as to business, stage lines, baggage delivery, etc. The Vice-Chancellor said that from all he could see the company was entering into highly profitable enterprises which were entirely within the range of its charter. He then denied the motion. After the hearing President Sanderson of the company announced that the company would proceed against delinquent stockholders by the advertisements of their names and holdings and by the sale of such part of them as was necessary to meet the allotment.

REFUSING TELEPHONE SERVICE.—At Indianapolis an application to transfer to the Supreme Court the case of the Rushville Coöperative Telephone Company vs. Arthur B. Irvin, which was recently reversed by the Appellate Court, was denied. The application was based on the fact that the appeal presented a new question of law, as follows: Can a telephone company arbitrarily discontinue the telephone service of one of its patrons, or refuse to grant him service after said discontinuance, on the ground that he is indebted to it for a preceding month's telephone service, and can it require him first to pay its bill for service and then resort to an action at law to recover what the company owes him? Irvin had a claim against the company for about the same amount as he owed it, and refused to pay except by giving a receipted bill, and the Appellate Court held that the company had a right to disconnect his telephone until he paid. The refusal to transfer was on the ground that the recent act providing for such transfers was not retroactive and that this appeal was decided before that act took effect.

OBITUARY.

MR. I. C. SMITH, of New York City, an inventor of steam and electrical engines, committed suicide last week in his apartments. The Northern Pacific panic in Wall Street caused a firm who were to finance one of his inventions, an electric motor, to abandon the project, it is said, and this made him despondent. He was fifty-eight years old.

MR. A. L. JOHNSON.—We regret to note the death of Mr. A. L. Johnson, from aneurism of the heart at his beautiful residence in Brooklyn, New York, on July 2. He was a brother of "Tom" Johnson, and had been closely associated with that trolley railway builder in all his enterprises, such as those in Cleveland and Brooklyn. Of late he had been interested in plans for trolley roads in England, and between New York and Philadelphia. He leaves a wife and four children.

MR. S. SIAS.—We regret to note the death of a pioneer in the field of electric lighting development, Mr. Samuel Sias, treasurer of the Boston Electric Light Company, who died last week at his home, in Cambridge, Mass., aged fifty-eight years. Mr. Sias had been treasurer of the Boston Electric Light Company since its incorporation and was a large stockholder. He was also a director of the American Pneumatic Service Company. He was a member of the Exchange and Algonquin clubs.

CAPT. JAS. D. RANDALL, president of the Southern Independent Telephone Association, died at his home, in Memphis, Tenn., on Friday morning, June 21, at 2 o'clock, after several weeks' illness. The remains were buried in Elmwood Cemetery, Memphis, on Saturday, June 22. Capt. Randall was for seventeen years a steamboat captain on the Mississippi River. For a number of years he has given his time exclusively to electrical engineering, especially in the telephone line. He was instrumental in building several telephone exchanges and was one of the telephone pioneers. About three years since he took an active part in organizing the Southern Independent Telephone Association, of which he was elected president, which position he held until his death. Capt. Randall was a man in the true meaning of the word and a true friend; a good citizen; a good husband and a Christian. Mr. Randall did more to build up the Southern Independent Telephone Association than any other member.

PERSONAL.

MR. LOUIS E. BEILSTEIN, of Cleveland, O., has been appointed general manager of the Toledo Traction Company's lines.

MR. FRANCIS W. HEISLER, purchasing agent of the American Bridge Company, has tendered his resignation, to take effect July 1.

MR. JAMES K. PUMPELLY, of Chicago, has become associated with the National Automobile & Electric Company, of Indianapolis.

MR. WARRALL WILSON has been elected president of the Detroit & Chicago Traction Company, which is building a trolley line between those cities.

MR. D. F. LEWIS and MR. W. A. BOLAND have been elected directors of the Brooklyn & Rockaway Beach Railroad Company, succeeding T. L. Frothingham and H. J. Robinson.

MR. W. S. TRUESDALE, of the Postal Telegraph service at Columbus, O., has been made assistant superintendent of the western division of the Postal system, with headquarters at Chicago.

MR. A. L. SELIG has become manager of the Redlands Electric Light & Power Company (California), in place of Mr. G. B. Ellis, who has resigned to accept a position with the California Power Company.

MR. G. R. WEBB has succeeded Mr. Nelson Perin as president of the United Railways Company, of Baltimore, and also takes his place as president of the United Electric Light & Power Company, of that city.

MR. E. J. HALL, JR., vice-president of the American Telephone & Telegraph Company, who has long had special care of the development of the "long-distance" service, has just returned from a trip to Europe.

MR. A. K. WARREN, the well-known electrical manufacturer and engineer, has lately become associated with the Brooklyn Rapid Transit System, on the staff of Mr. H. H. Williams as assistant engineer, in charge of line and equipment.

MR. F. P. FISH returned home from Europe last week and now assumes his new responsibility, the presidency of the American Telephone & Telegraph Company. The course of Bell interests under his management will be watched with the keenest interest.

JUDGE J. M. THOMAS has, it is stated, accepted the presidency of the Telephone, Telegraph & Cable Company, of America, on the condition, among other things, that a vigorous and aggressive campaign of "independent telephony" shall be inaugurated.

MR. E. R. THOMAS, son of Gen. S. Thomas, was married last week to Miss Linda Lee, daughter of Mr. W. P. Lee, treasurer of the Louisville (Ky.) Gas & Electric Light Company. Mr. Thomas was elected president of the failed Seventh National Bank last week.

PRESIDENT C. A. COFFIN, of the General Electric Company, has just returned from England, having accomplished the object of his mission—namely, securing control of the British Thomson-Houston Company, for which, it is rumored, other concerns had been quietly negotiating.

MR. ROBERT McF. DOBLE, mechanical and electrical engineer, and Lewis A. Hicks, hydraulic engineer, both well known through their connection with various Pacific coast water power transmission schemes, have formed a partnership, to be known as Doble & Hicks, and will act as consulting engineers in matters pertaining to electric power transmission, water supply, pumping, refrigeration, sewage and irrigation. Their offices will be in the Mills Building, San Francisco.

MR. J. W. ELLARD, the former general manager of the United Electric Light & Power Company, of Baltimore, Md., has become a member of the firm of J. L. Blackwell & Company. Mr. Ellard, besides being an expert on electric lighting, is also an expert on street railways, both in their financial and mechanical features. He will look after work of this sort for J. L. Blackwell & Company, whose general business is to build and finance electric light and power plants and electric street railways.

Trade Notes.

OIL FILTERS IN PORTO RICO.—The Burt Manufacturing Company, of Akron, Ohio, has recently equipped the San Juan Light & Transit Company with Cross oil filters.

SMETHURST & ALLEN, the Electrical engineers and contractors of Philadelphia, have moved their offices to the North American Building, below Chestnut Street, in that city.

MANHATTAN GENERAL CONSTRUCTION COMPANY.—The New York sales office of the Manhattan General Construction Company is changed from 11 Broadway to 120 Broadway.

THE PHELPS COMPANY, makers of the regulating "Hylo" incandescent lamp, are removing their factory to Detroit, Mich., corner of State and Rowland Streets, where they will enjoy enlarged facilities.

WARD LEONARD ELECTRIC COMPANY, of Bronxville, N. Y., has issued neat and handsome binders in which to keep its bulletins in regard to rheostats, motor speed controllers, theatre dimmers, resistances, circuit breakers, etc.

DENTAL AND SURGICAL AIR PUMP.—In Bulletin No. 3030 of the Emerson Electric Manufacturing Company, St. Louis, Mo., is described and illustrated a dental and surgical air pump operated by direct or alternating current motor.

FALCON PANEL BOARDS.—The Falcon Electric Manufacturing Company, 432 East Seventy-first Street, New York, has just issued Card No. 12, giving illustrations, dimensions and price lists of its Nos. 202 and 203 all-copper straight fuse panel boards for 125 volts.

U. S. EMIGRANT STATION.—The contract for covering at the U. S. Emigrant Station, Ellis Island, New York Harbor, has been awarded to the H. W. Johns Manufacturing Company, 100 William Street, New York City. This contract amounts to $6,666.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has issued a complete catalogue of telephone and annunciator systems, in addition to its regular telephone catalogue. Contractors and telephone men who have been missed in the distribution will be supplied upon application.

BARGAIN SHEET.—The Emerson Electric Manufacturing Company, St. Louis, is offering some bargains in alternating current fan motors of the desk and ceiling types. A description of these machines is given in a bargain sheet just issued by the company, a copy of which may be had on application.

THE UNION MICA COMPANY, 56 Pine Street, New York, which has been preparing for several months to enter the electrical field is now fully equipped with one of the most modern factories in existence and is ready to fill all orders promptly. Its own mines, machinery, etc., greatly add to its facility.

THE GOULD STORAGE BATTERY COMPANY, New York, announces that, in addition to its regular product, it now manufactures high output electric vehicle batteries. A copy of the company's latest catalogue can be had by all interested on application to the company's office, at 25 West Thirty-third Street, New York.

NEW MILLING MACHINES.—The Cincinnati Milling Machine Company, Cincinnati, Ohio, has brought out some milling machines of new pattern. These machines are described and illustrated in a catalogue just issued by the

company. Examples of these machines may be seen in operation at the Pan-American Exposition.

LUNDELL MOTORS.—Bulletin No. 206 of the Sprague Electric Company covers the broad subject, "Lundell Motors." All of the different styles of this well-known type of motor are described and illustrated, and tables give the dimensions of each type. Illustrations and descriptions of the brush-holder mechanism and Lundell controllers are also included in the bulletin.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that it has recently closed a number of very large contracts for apparatus in the West and Southwest. It is offering for alternating current apparatus the Warren alternator and direct current Eddy generators and motors. Bulletins, descriptive matter, etc., on this material will be mailed upon application.

"THE THOROUGHFARE OF THE NATION."—In a recent article on the growth of the traffic on the New York Central, the Rochester *Herald* says: "The New York Central may well be called the thoroughfare of the nation." people living in the cities of 8,000 or more inhabitants, more than one-half live or more inhabitants, two-thirds live along the New York Central lines.

THE S. K. C. SYSTEM.—In a neat sixteen-page pamphlet the Stanley Electric Manufacturing Company, Pittsfield, Mass., gives a synopsis of its system. The pamphlet is well illustrated with small views of different types of machines and auxiliary apparatus. It also includes a description and illustration of that company's device for handling extreme potential, which was described and illustrated in these columns last week.

FAN MOTOR EFFICIENCY.—A private mailing card being sent out by the Emerson Electric Manufacturing Company, St. Louis, Mo., gives two curves plotted from actual tests, showing the comparative efficiency of alternating current desk fans, compiled from velocity of air moved and current consumption. These curves are an interesting study, and tell at once, to the eye, the results obtained under the two different conditions.

MESSRS. GARDNER & ROBINSON, 1522 Monadnock, Chicago, announce that they have recently made arrangements to furnish all kinds of heavy steel plate work, including tanks, draught stacks and blast furnace work. They are also prepared to supply ore, cinder and hot metal buggies, etc. This work will be manufactured for them by the Enterprise Boiler Company, of Youngstown, Ohio, which concern the firm represents in Chicago territory.

THE RICHMOND ELECTRIC WIRE CONDUIT COMPANY, through its main Eastern representative, Mr. W. S. Brown, 39 Cortlandt Street, tells us that its business is increasing so rapidly that, beginning with June 24, it will start in to run two shifts daily, a day shift and a night shift, making a total of 120 hands employed. It has found this to be necessary to keep up with orders, as its conduit has met with great approval throughout the entire country.

AIR COMPRESSORS.—The New York and Franklin Air Compressor companies have gotten out a handsome catalogue of their air compressors acuated by steam, belt, gearing, electricity, water power or any other form of power. The catalogue is very artistically illustrated with views of compressors of different types and various constituent parts. The descriptive text is quite complete. and tables give the dimensions of the various sizes of the different classes of compressors.

AUTOMATIC TELEPHONE METER.—The Automatic Telephone Meter Company, 620 Atlantic Avenue, Boston, Mass., gives in a card folder a brief description of its automatic meter, and points out the advantages to be derived from the use of this device. This meter can be connected to any telephone system, without interfering in any way with the existing connections. It records each outgoing call when the desired connection is obtained, but does not record incoming calls.

GENERAL ELECTRIC LITERATURE.—Woven wire and copper wire brushes constitute the subject of Bulletin No. 4249, issued recently by the General Electric Company. The publication bureau of the company has issued an index to its bulletins from No. 4200 to 4250. This will be appreciated by all having a file of General Electric bulletins. Among other recent publications of this company are catalogues and price lists of repair parts of GE—60—A railway motor for 250 and 500 volts and parts of CB—14 A and H motors. Flyer No. 2071 relates to manhole fuse boxes.

ARC LAMP SOUVENIR.—The Lea Electric Manufacturing Company, Elmwood, Ind., is distributing at its exhibit in Electricity Building, Pan-American Exposition, Buffalo, N. Y., a neat folder containing some poetry which sounds the praises of the "Northall" swinging cover enclosed arc lamp. An illustration of the lamp has the case divided vertically in two halves, each half being fixed to the card by an eyelet, thus permitting it to be swung outwardly, to illustrate the construction of the actual lamp case.

NIAGARA FALLS BRIDGE.—We have received from Mr. R. D. Lillibridge, 20 Broad Street, New York, a miniature steel engraving of the Pencoyd arch bridge spanning the Niagara Gorge, between Niagara Falls and Clifton. The engraving is on the five-cent stamp of the Pan-American series and is an excellent picture of this beautiful span, which is stated to be the largest in the world, being 840 feet. The bridge was built in 1898 by the Pencoyd Iron Works, now the Pencoyd plant of the American Bridge Company.

FIFTIETH ANNIVERSARY.—The Lane & Bodley Company, Cincinnati, O., in a circular announces the completion of half a century of its successful existence. The circular contains illustrations of the first type of engine made by the company and the latest type "The Twentieth Century Engine." The first engine made was of a small wall type, which one man could lift; the latest type weighs hundreds of tons. One of the twentieth century engines is in operation at the Pan-American Exposition in Machinery Building.

COAL HANDLING APPARATUS.—The Robins Conveying Belt Company, New York, describes its system of coal handling by means of Robins' belt conveyors, in a large, handsomely illustrated pamphlet of recent issue. The pamphlet contains twelve half-tone illustration, 6 ins. x 9 ins., of installations of the system in as many different plants, and one illustration, 6 ins. x 20½ ins., gives a view of a Canadian shipping pier, similarly equipped. Besides these illustrations, there are many other smaller one, some showing the apparatus and constructive parts.

BULLOCK COMPANY AT THE PAN-AMERICAN.—The Bullock Electric Manufacturing Company, Cincinnati, O., is sending out a handsome Pan-American souvenir, in the form of a pamphlet, to serve as a reminder of the company's line of direct current machinery. The pages contain half-tone illustrations of various types of generators and motors, also of machine tools, each illustration being accompanied by a memorandum of the points of excellence of the machine under consideration. The cover is handsomely illuminated with the coats of arms of the different countries represented at the exposition.

THE AMERICAN ELECTRICAL HEATER COMPANY, Detroit, calls attention to the interesting fact that while its apparatus is available and useful all the year round, it is also during the summer months that they are very highly appreciated. For instance, the soldering irons, tailor irons and laundry irons can be heated by simply connecting with the electric light socket, and thus avoid the necessity of having a hot fire to heat up the room where the irons are being used. This is a point well worth considering. The American Electrical Heater Company makes a very full line of this apparatus, and is glad to send its catalogue to any one who applies for it.

STURTEVANT.—The new plant of the B. F. Sturtevant Company at Hyde Park, Mass., sketch plans for which are now well under way, will probably provide about eight acres of floor space, fully double that existing in the old plant at Jamaica Plain. Nearly one-third of this area will be devoted to the manufacture of engines, motors and generating sets. The recent growth of this department has been almost phenomenal, and it is in this field—particularly in the application of Sturtevant motors to Sturtevant fans—that the most rapid growth is expected in the immediate future. The entire plant will be equipped with Sturtevant generating sets and motors for direct driving of line shafts and of large individual machines.

STILWELL FEED WATER HEATERS.—The following is a list of shipments of heaters made recently by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, O.: Arnold Electric Power Station Company, Jenison, Mich., one size G improved heater and lime extractor; F. Hammer Paint Company, St. Louis, Mo., one No. 1 cast-iron heater; American Steel Hoop Company, Allegheny, Pa., one No. 6 cast-iron heater; Kroutil Bros. & Tyola, Geary, Okla. Ter., one size B improved heater; H. & L. P. Patton, Clarkesville, Tex., one No. 5 feed water heater; Florentine Pottery Company, Chillicothe, O., one No. 6 feed water heater; Western Tube Company, Kewanee, Ill., one No. 6 cast-iron heater; Pocahontas Collieries Company, Pocahontas, W. Va., one size H improved heater; Carter & Son, Paris, Tex., one No. 7 feed water heater; Leland Oil Works, Leland, Miss., one size E heater; Stephensville Oil Mill Works, Stephensville, Ga., one size E 2 heater; J. T. Bradley & Company, St. Louis, Mo., one E 2 feed water heater; Auld & Conger, Poultney, Vt., one size C feed water heater; H. P. Deuscher & Co., Hamilton Ohio, one size D heater; Geo. Hull, Paris, Tex., one No. 5 feed water heater. The above heaters, designated as "feed water heaters" and "improved heaters," are of the wrought-iron type.

A LARGE ELECTRICAL SUPPLY CATALOGUE.—A large catalogue is generally an indication of a large business, and it is quite safe to make this affirmation in the case of the Manhattan Electrical Supply Company, 32 Cortlandt Street, New York, who has just issued a catalogue that it may well be proud of. The catalogue contains no less than 464 pages within the covers, and is very completely illustrated with cuts of the extensive and varied lines of electrical supplies manufactured and handled by the company. About the only electrical apparatus not listed are dynamos and street railway motors; every other line is fully covered. The supplies listed include those for electric light, telephone, telegraph, railway and the household. Electric light supplies alone take up about 150 pages; the telephone section, while not so large, is very complete and varied. Batteries, bell outfits, gongs, etc., take up many pages, and very complete lines of working tools, measuring instruments and special devices are illustrated. It would be impossible to enumerate even a small part of the contents of the catalogue in the limited space at our command. Suffice it to say that everything in the departments above mentioned, that any one is ever likely to call for, is listed.

RUBEROID IN THE ARCTIC.—Arctic explorers heretofore have had to face many perils and discomforts that do not now confront Evelyn B. Baldwin, the leader of the Baldwin-Ziegler Polar Expedition, who has just sailed for Dundee, thence to proceed to San Josephsland, whence the complete expedition starts for the Arctic regions. Everything that money can buy or experience suggest to insure safety and comfort to Leader Baldwin and his companions has been procured. The cargo of the "America" includes a large quantity of Ruberoid roofing, manufactured by the Standard Paint Company, New York and Chicago, and a large amount of galvanized wire netting. This Ruberoid is to be used as a housing or enclosure for the ship when the ice stops its further progress, and as a covering for the huts or "shelters" erected along the route for the forty men, the hundreds of dogs and other animals and the supplies. The galvanized iron wire will be used as a frame work or support for the Ruberoid, which will be laid over it. The small amount of space occupied by Ruberoid proves to be extremely desirable on Arctic expeditions. Ruberoid meets all the requirements of the situation. It is made of the strongest kind of felt, light in weight and easily laid over wire frame-work, comes in compact rolls of convenient size for easy transportation. The progress of an Arctic exploring party is necessarily slow, because only a portion of the trip can be made by water. The rivers become clogged with ice, and as the explorers proceed northward the ice closes in solidly about the ship, making further navigation impossible. The vessel is then abadoned and the remainder of the journey is made over the ice on sleds drawn by dogs. To insure the safety of the ship, however, during its long imprisonment in the ice a strong wind-proof and water-proof building is erected about and over it. During the journey over the ice the Baldwin party will erect Ruberoid huts, or "shelters," at different stations along the route, which will shield the explorers and their retinue from the biting winds and the cold. These shelters are not torn down when vacated, for they serve as storehouses for supplies and provisions, to be used on the return trip.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JUNE 25, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

676,881. SELF-LOCKING INSULATOR AND PIN; H. Etheridge, McKeesport, Pa. App. filed May 9, 1901. The insulator pin is hollow and a spring, having a hook at each end, passes through the pin and engages with the insulator at one end and the cross-arm at the other, thus locking the insulator while permitting it to rotate.

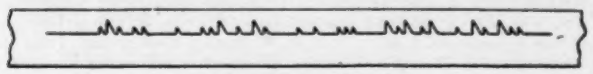
676,888. ELECTRIC RAILWAY SYSTEM; E. Frischmuth, Berlin, Germany. App. filed Feb. 12, 1900. The frame running in the conduit carries a spring-actuated arm, which bears against the conductor; by swinging the frame to one side, the arm can be withdrawn from the conductor.

676,939. TELEGRAPHIC CODE; C. G. Burke, Brooklyn, N. Y. App. filed March 29, 1900. A telegraphic code, in which the signal elements are distinguished from one another by a difference in length and by their relation to a given zero position, and in which each group or combination of elements which represents a given letter or character is made up of elements having the same relation to such zero position.

676,949. ELECTRIC HEATER; G. C. Hawkins, Boston Mass. App. filed Sept. 26, 1898. A fan is combined with an electric heater in such a way that the heated air is distributed from the heater.

676,952. ELECTRIC LAMP; C. A. Hussey, New York, N. Y. App. filed Oct. 23, 1900. One lamp globe containing a filament is formed inside of another, the structure being adapted to fit a socket provided with switching devices for throwing either filament into operation.

676,955. TELEPHONE SYSTEM; F. A. Lundquist, Chicago, Ill. App. filed Dec. 23, 1899. A series of telephones, each of which is provided with a movable switching mechanism, a central station provided with connections



676,939.—Telegraphic Code.

to said telephones, a spring-jack located at said central station, a device for covering the openings to said spring-jack, and means whereby the movements of said device to cover said openings will cause all moved mechanisms to be returned to their normal position.

676,956. CALLING DEVICE FOR TELEPHONE EXCHANGES; F. A. Lundquist, Chicago, Ill. App. filed Jan. 8, 1900. Details.

676,965. MEANS FOR RECHARGING STORAGE BATTERIES OF ELECTRIC VEHICLES; Joseph Sachs, of Hartford, Conn. App. filed Oct. 5, 1900. Provides means to recharge the battery when the vehicle is running free or is having its speed reduced with the motor shut off—the charging being regardless of the speed in either case. The motor has a supplemental field, which is thrown into the circuit when the vehicle is coasting and cut out when the motor is driving the vehicle. By this means the field strength may be increased and thereby an e. m. f. higher than the normal produced for charging the battery, even when the speed of the vehicle varies over a large range.

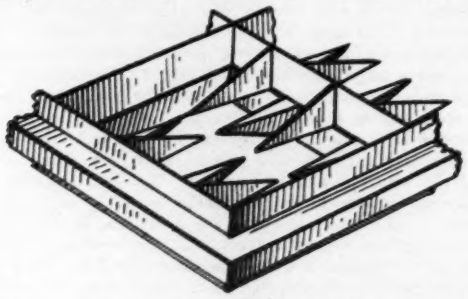
676,976. CONDUIT CAPPING OR THIMBLE; W. F. Bossert, Utica, N. Y. App. filed March 29, 1901. The thimble is provided with threads to engage the end of the conduit and with a curled edge forming an abutment for the end of the conduit, and a smooth finish.

676,985. ELECTRIC SMELTING FURNACE; H. Koller, Nuremberg, Germany. App. filed May 17, 1900. (See Current News and Notes.)

677,005. FEEDING AND REGULATING MECHANISM FOR ARC LAMPS; W. E. Waldron, Colorado Springs, Col. App. filed Feb. 6, 1901. Details of construction.

677,019. ELECTRIC ARC LAMP; F. M. Conway, New York, N. Y. App. filed July 18, 1898. Details of construction.

677,026. ELECTRIC BRAKE; F. W. Garrett, Johnstown, Pa. App. filed



677,244.—Secondary Battery.

Oct. 24, 1900. An electro-magnetic frictional brake, adapted to be energized by current furnished by the motors when connected on a short circuit to run as generators.

677,027. OPERATING MEANS FOR ELECTRIC CONTROLLERS; F. W. Garrett, Johnstown, Pa. App. filed Nov. 27, 1900. A guard plate covers the handle of the reverse switch and can be removed only by throwing the main control handle to the open position.

677,038. CONTROL OF ELECTRIC MOTORS; F. A. Merrick, Johnstown, Pa. App. filed Nov. 14, 1900. Certain new combinations in series-parallel control.

677,049. ELECTRIC LAMP CLUSTER FIXTURE; N. Weeks, New York, N. Y. App. filed Oct. 4, 1898. An electric light lamp cluster, consisting of a base having metallic receivers for a number of lamps and a separated and independent finishing cap having openings to permit the insertion of the lamps in the receivers and bushed with insulating material.

677,070. ELECTRICAL HEATING FURNACE; A. H. Eddy, Windsor, Conn. App. filed June 15, 1900. (See Current News and Notes.)

677,071. COLLECTOR FOR ELECTRIC GENERATORS AND MOTORS; A. H. Eddy, Windsor, Conn. App. filed March 27, 1901. A collecting brush composed of a cemented mixture of particles of oxide of metal and particles of pure metal.

677,145. COMBINED BRAKE AND POWER CONTROLLER; E. W. Stull, Johnstown, Pa. App. filed Sept. 28, 1900. The switch cylinder carries on one portion of its surface the necessary contacts for series-parallel control, and on another portion the necessary contacts for throwing the motors onto a closed circuit with reversed connection for generating a current to supply the brake.

677,156. SYSTEM OF CHARGING STORAGE BATTERIES; Geo. Herbert Condict, of New York. App. filed Aug. 4, 1898. Relates to a complete arrangement of electrical apparatus, circuits, switches, cut-outs and signals for charging storage batteries. There is a common source of supply, a plurality of circuits of different potential, actuating means for controlling these circuits, including signals and a single operating means for connecting the battery circuit in the circuits of different potential.

677,169. ALARM APPARATUS FOR ENGINE ROOM TELEGRAPHS OR THE LIKE; T. Bell, Liverpool, Eng. App. filed Sept. 22, 1900. Details.

677,191. ELECTRIC CONTROLLER; A. C. Eastwood, Cleveland, Ohio. App. filed Feb. 6, 1901. A frame adapted to support the contacts and resistances in such a manner as to be readily accessible for inspection and repairs.

677,207 and 677,208. PROCESS OF PURIFYING BAUXITE; C. M. Hall, Niagara Falls, N. Y. App. filed Dec. 19, 1900, and Feb. 2, 1901. (See page 14.)

677,209. PURIFIED CRYSTALLINE ALUMINA; C. M. Hall, Niagara Falls, N. Y. App. filed Feb. 20, 1901. (See page 14.)

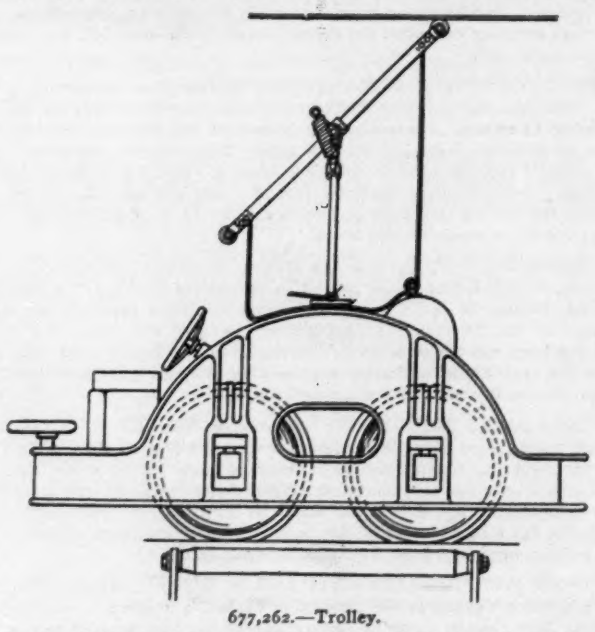
677,226. METHOD OF PRODUCING ELECTRICAL ENERGY FROM CARBONACEOUS MATERIALS; H. Jone, Chicago, Ill. App. filed July 8, 1899. (See Current News and Notes next week.)

677,238. INCANDESCENT LAMP; I. Kitsee, Philadelphia, Pa. App. filed March 2, 1900. (See Current News and Notes.)

677,244. SECONDARY BATTERY; A. F. Madden, Newark, N. J. App. filed March 19, 1901. The important feature of this invention is a grid formed by compression between dies and having openings within surrounding walls and pointed fingers projecting into the openings from the walls, the active material closing the openings and surrounding the fingers.

677,247. ELECTRICALLY OPERATED PLOW; C. Meissner, Friedrichsberg, Germany. App. filed Dec. 31, 1900. Details.

677,262. TROLLEY; A. Palmros, Columbus, Ohio. App. filed Oct. 9, 1899. A hinged and reversible frame having an elongated trolley roller at each end and means for pressing upward either end of the frame, according to the direction of movement of the car.



677,262.—Trolley.

677,269. REVERSIBLE SNAP SWITCH; G. H. Proctor, Somerville, Mass. App. filed Oct. 17, 1900. Details.

677,296. CIRCUIT TESTING AND RECORDING APPARATUS; G. A. Wall, Providence, R. I. App. filed Feb. 17, 1899. The invention is an apparatus which, when set in motion, acts automatically to complete the circuits which are to be tested and to make a record of the condition of those circuits while returning to its normal condition.

Reissue 11,916. ELECTRIC ARC LAMP; Edwin W. Rice, Jr., of Schenectady, N. Y. Original app. dated Jan. 23, 1900. App. for reissue filed May 1, 1901. (See Current News and Notes.)